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ABSTRACT

This report focuses on standards for the teaching and learning of biology in the state of Mississippi. It contains sections on interpreting the Mississippi subject area score reports, an overview of the Mississippi Biology I curriculum, suggested test strategies, additional teaching strategies with sample assessment items, and skills needed for success on the Biology I Subject Area Test. (DDR)

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ED 466 388

Instructional Intervention Guide

Biology I

2001

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INTRODUCTION

The study of Biology I taught in Mississippi secondary schools, builds on knowledge of life and life processes acquired from grades kindergarten through eighth. This scope and sequence requires that the student bring from previous grades a basic understanding of science, which is outline in the framework by competencies for grades kindergarten through eighth grade. The 2001 Science Framework Writing Committee recommends:

> "Elementary science education is essential. The concepts, principles, processes, and skills must be acquired in order to comprehend what students see, hear, read and interpret. Science at the elementary level can be used to enhance reading comprehension and should be an integrated part of elementary education."

Therefore, students taking Biology I should have a basic knowledge of science, gained in grades kindergarten through eighth, which will enable them to apply scientific methods of inquiry and research in examination of the following basic topics: chemical basis of life; cell structure, function, and reproduction; energy; molecular basis of genetics; natural selection and diversity; and ecology.

This document was designed and developed to enhance and supplement the *2001 Mississippi Science Framework* and the Subject Area Testing Program (SATP) teacher's guide. This **Intervention Guide** is designed to help the teacher assess the deficiencies of the student by assessment strand as reported in the **SATP Student Report.** The student report is explained in steps to help give the individual teacher, counselor, or administrator, a means to determine and develop a clear assessment of the student's performance.

In addition, the intervention guide also gives a clear overview of how to use the *2001 Mississippi Science Framework*. Although the Framework provides numerous teaching strategies in its curriculum guide, additional strategies with more comprehensive explanations and sample assessment questions are provided. Teachers should note that many questions, referred to as enhanced multiple choice, will require students to apply the knowledge and skills gained in Biology I to solve practical, "real life " problems. This intervention guide should be used as a tool to aid in making the connections between the Science Framework and the Biology I Subject Area Test Program.

Because the Biology I Subject Area Test is a performance-based assessment, it is essential that teachers not only design instructional strategies that communicate basic biological knowledge to students but also instruct students in how to process and manipulate the information. The Biology I Subject Area Test measures understanding of basic biological concepts, the use of science skills and application of biology to real-world problem solving and decision-making. Students will be interpreting data, applying concepts, drawing conclusions, and explaining their own ideas. It is imperative that students taking the Biology I course be exposed to various teaching methods that allow them to develop these skills. Instruction should go beyond the traditional use of a singular textbook and worksheets, and use a wealth of related materials and resources to convey information and skills to the students.

Section I

Interpreting the Mississippi Subject Area Score Reports

Assessment Strands

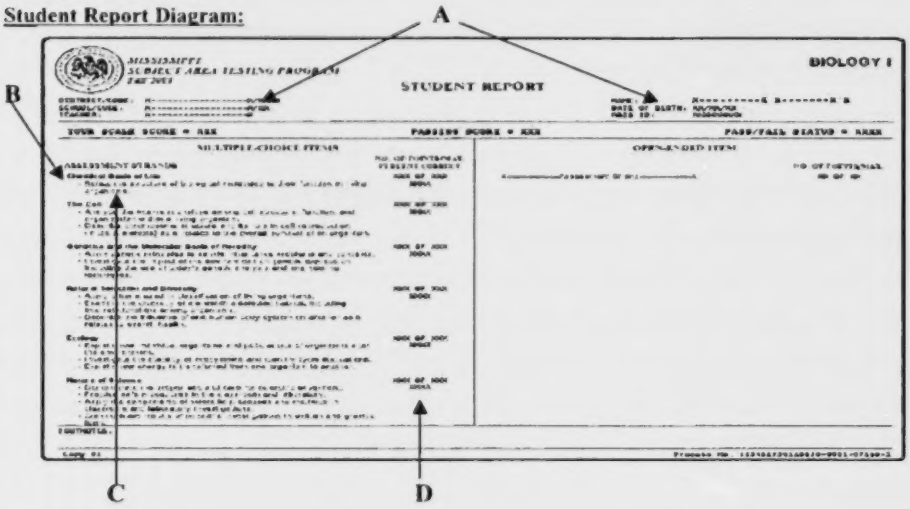
The Mississippi Subject Area Student Report contains information on a student's performance on the Biology I Subject Area Test. The report is broken down into the six assessment strands:

1. **Nature of Science**
2. **Chemical Basis of Life**
3. **The Cell**
4. **Genetics: The Molecular Basis of Heredity**
5. **Natural Selection and Diversity**
6. **Ecology**

Mississippi Subject Area Test Student Report

a. The item marked **"A"** identifies the information relevant to the district, school, teacher and student.
b. The item marked **"B"** identifies the assessment strand.
c. The item marked **"C"** identifies the competencies tested in each assessment strand.
d. The item marked **"D"** identifies the number of questions answered correctly, the number of questions pertaining to the assessment strand, and the percentage of correct responses in that assessment strand.

Student Report Diagram:



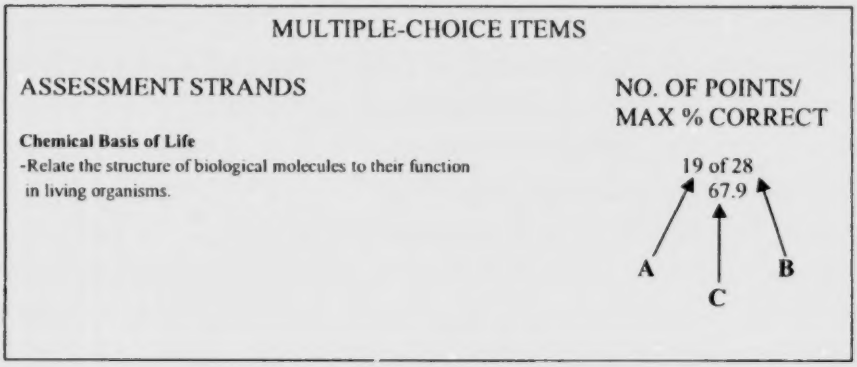
Student Performance Information

Refer to items on the Student Report diagram below.

Note: There are three numbers next to each assessment strand.

a. The first number labeled **"A"** is the number of questions the student answered correctly.
b. The second number labeled **"B"** is the number of questions that were on the test related to that assessment strand *(These numbers are from the test blueprint).*
c. The last number **"C"** is the percentage of correct student responses for that assessment strand.

Enlarged section of Student Report Diagram:



While test score reports provide scaled scores for each of the strands, it is the performance on the overall test that is of primary importance. Scores specifically reported by assessment strand are provided in order to give students, teachers, and administrators an idea of the student's relative strengths and weaknesses. It is important to remember that while the overall difficulty of the tests remains the same from one version of the test to the next, the difficulty in a particular strand may vary.

Class Performance Report

1. The item marked as **"A"** identifies the information relevant to the district and school.

2. The section labeled as **"B"** gives the total number of students who received score on-
   a. The multiple choice questions.
   b. The constructed response questions.
   **The total number given is the total number of questions scored in both categories.*

3. The section labeled as **"C"** identifies the total number of points possible in each assessment strand. Also identified here are the total number of possible points in the open-ended question strand.

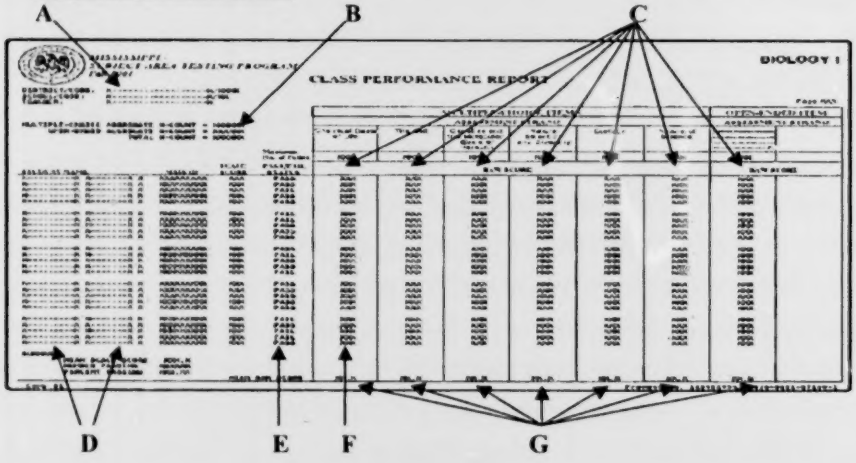
4. The section labeled **"D"** gives the list of the students taking the test by last name, first name and middle initial.

5. The column **"E"** gives student's status on the Subject Area Test in terms of their passing or failing.

6. The columns such as the one labeled as **"F"** provide the number of points each student received in each assessment strand.

7. The numbers at the bottom of each assessment strand column labeled as **"G"** is the *mean raw score*, or an average number of correct responses, in a given strand.

Class Performance Report:



Student Roster and Summary

1. The section labeled **"A"** identifies information relevant to the district, school, and teacher.

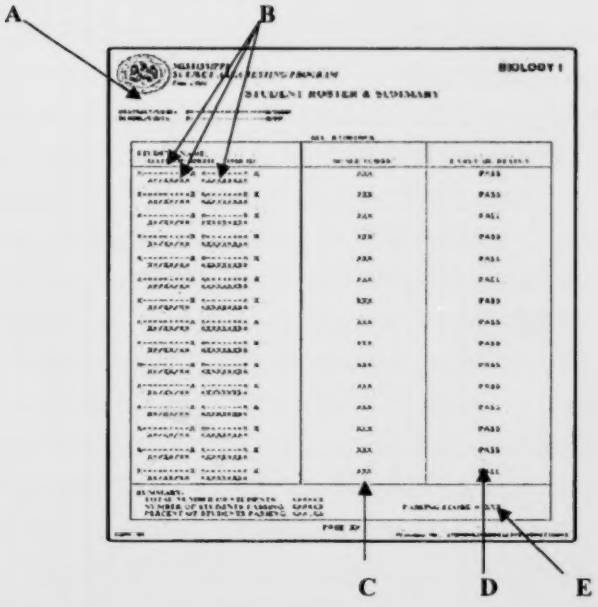
2. The section labeled as **"B"** gives the lists of students who have taken the test and lists them by:
   a. Last name, first name, middle initial
   b. Date of birth
   c. Mississippi student information system number

3. The column labeled as **"C"** lists the scaled score for each student.

4. The column labeled **"D"** gives the student status in terms of passing or failing the Mississippi Subject Area Test.

5. The item labeled as **"E"** denotes the minimum score needed to pass the Mississippi Subject Area Test.

Student Roster and Summary:



Section II

Overview of Mississippi Biology I Curriculum

Framework Organization

The Framework is organized by grade level (K-8) and by course at the secondary level. A general description that includes the purpose, overview and suggested prerequisites is found preceding each curriculum outline for the grade level or course.

A correlation has been developed to show the relationship of the 2001 Mississippi Science Framework to the 1996 Mississippi Science Framework. This should assist in understanding the connection between the 1996 and the 2001 documents. (See Appendix E)

The *Mississippi Science Framework* format is described and outlined in the description and diagram below.

1. The item "**A**" denotes the ***Course*** described.
2. The item "**B**" denotes the ***Strands*** integrated in the course described. There are three overlapping content strands in science: ***Life Science, Earth and Space Science, and Physical Science.*** They should be integrated throughout the framework.
3. The item "**C**" denotes the ***Competencies***. The competencies, printed in bold face type, are the part of the framework that is required to be taught to all students in the course.
4. The item "**D**" denotes the ***Suggested Teaching Objectives.*** The suggested teaching objectives are not required to be taught but serve as a suggested guide to be used in teaching the course.

FRAMEWORK DIAGRAM:

BIOLOGY I ← **A**

CONTENT STRANDS:

Life Science (L)
Earth and Space Science (E) ← **B**
Physical Science (P)

COMPETENCIES and Suggested Teaching Objectives:

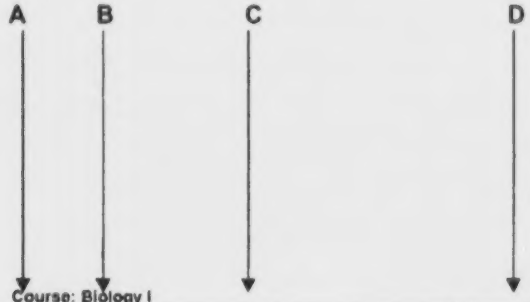
1. Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E) ← **C**

a. Demonstrate the proper use and care for scientific equipment used in biology.
b. Observe and practice safe procedures in the classroom and laboratory. ← **D**
c. Apply the components of scientific processes and methods in the classroom and laboratory investigations.
d. Communicate results of scientific investigations in oral, written, and graphic form.

Suggested Curriculum Guide

1. The ***competency*** that is required to be taught is listed in the first column. **(A)**
2. The ***suggested teaching objectives*** for that competency are listed in the second column.**(B)**
3. A ***suggested teaching strategy*** for the desired competency and objective is listed in the third column. **(C)**
4. A ***suggested method of assessment*** for the teaching strategy is listed in the fourth column. **(D)**

CURRICULUM GUIDE:



Course: Biology I

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
1	a	• Review laboratory equipment and uses with students; set up lab practical or measurement lab where they have to individually demonstrate proper use	• Performance assessment checklist
1	b	• Review safety rules with students, watch lab safety video, complete safety contracts.	• Performance assessment during year; quiz on safety
1	c	• Let students design an original experiment using sponge animals and hot water, seed germination, etc. Also give students experiment scenarios and let them pick out variables, controls, write hypothesis, etc.	• Teacher rubric • Student responses • Graded test
1	d	• Let students collect data from experiments and summarize, graph, and present to class.	• Rubric and checklist

Biology I Competency and Objectives Survey

The following survey was used by Biology I teachers to rate the importance of competencies and objectives in the Biology I framework. From the results of this survey the Office of Student Assessment built the test blueprint for the Mississippi Subject Area Test for Biology I.

Biology I Competency and Objectives Survey

To be completed by Biology I teachers only **Directions:** 1. For each of the competencies/skills listed below, circle "Yes" if you teach this in your classroom. 2. Circle 1, 2, or 3 to indicate the emphasis you believe the Biology I assessment should place on each competency/skill. 3. Return the questionnaire to your principal for mailing.	**Do you teach this competency /skill in your classroom? (Circle if yes)**	**How much emphasis should the Biology I assessment place on this competency? (Circle one)** **1=Little or no emphasis** **2=Moderate emphasis** **3=Strong emphasis**
Competency #1 **Analyze the interrelationships among cell structure, function, and organization within a living organism.**		
1.1 Explain cellular organelle functions as they relate to life processes in various living organisms.	Yes	1 2 3
1.1a Distinguish between prokaryotic and eukaryotic cells.	Yes	1 2 3
1.1b Compare and contrast plant and animal cell structures and their functions.	Yes	1 2 3
1.2 Compare the various types of tissues used in different organisms and how they relate to common functions.	Yes	1 2 3
1.2a Describe levels of organization from cell to organ system.	Yes	1 2 3
1.2b Relate tissue types to their function.	Yes	1 2 3
1.3 Explain the cell's response to its environment and stimuli.	Yes	1 2 3
1.3a Describe cell membrane structure and function in active and passive transport.	Yes	1 2 3
Competency #2 **Describe chromosome structure and its role in cell reproduction (mitosis, meiosis) as it relates to the overall survival of an organism.**		
2.1 Summarize how DNA becomes a chromosome and how this relates to genes.	Yes	1 2 3
2.1a Describe the structure of chromosomes.	Yes	1 2 3
2.2 Describe the beginning and ending products of mitosis, including the relationship of this process to growth, repair, and chromosome number.	Yes	1 2 3
2.2a Identify and describe the stages for the cell cycle.	Yes	1 2 3
2.3 Describe the beginning and ending products of meiosis, including the relationship of this process to reproduction, heredity, variation, and reduction of chromosome number.	Yes	1 2 3
2.4 Compare/contrast survival rates and variety in sexually and asexually reproducing organisms and explain the importance of these processes.	Yes	1 2 3

Competency # 3 **Apply genetic principles to simple inheritance problems and concepts.**		
3.1 Apply genetic principles to simple inheritance problems/concepts including mono-hybird crosses, dihybrid crosses, incomplete dominance, sex-linked transmission, gene-linkage, and multiple allelism.	Yes	1 2 3
3.1 a Construct and analyze mono-hybric crosses.	Yes	1 2 3
Competency #4 **Investigate the impact of the environment on genetic expression including the use of today's genetic analysis and engineering techniques.**		
4.1 Compare and contrast the relationship between mutations and genetic disorders including patterns of inheritance.	Yes	1 2 3
4.1 a Compare the effects of different kinds of mutations on cells and organisms.	Yes	1 2 3
4.1 b Research various mutagenic agents.	Yes	1 2 3
4.2 Explain advantages and disadvantages of using genetic engineering techniques today in plants, humans, and other animals.	Yes	1 2 3
	Do you teach this?	**Emphasis on Assessment**
4.3 Examine the applications of genetic screening.	Yes	1 2 3
4.3 a Use pedigrees/kayrotypes to examine the inheritance of genetic disorders.	Yes	1 2 3
Competency #5 **Apply criteria used in classification of living organisms.**		
5.1 Analyze the accepted classification schemes used for living organisms today.	Yes	1 2 3
5.1 a Identify and describe characteristics of the major kingdoms.	Yes	1 2 3
5.2 Apply the criteria of the classification system at the species level to common native organisms.	Yes	1 2 3
5.2 a Use a dichotomous key to classify organisms.	Yes	1 2 3
Competency #6 **Examine the diversity of life within a selected habitat, including interrelationships among organisms.**		
6.1 Describe how living organisms and nonliving materials interact within a competitive ecosystem.	Yes	1 2 3
6.2 Investigate major structural and functional characteristics of a representative vertebrate, invertebrate, vascular plant, and nonvascular plant.	Yes	1 2 3
6.2 a Compare and contrast vertebrate and invertebrate animal characteristics.	Yes	1 2 3
6.2 b Compare and contrast vascular and nonvascular plant characteristics.	Yes	1 2 3
6.3 Analyze a population growth curve to predict population growth patterns within an ecosystem.	Yes	1 2 3
6.4 Explain the mechanisms by which new species arise.	Yes	1 2 3
6.4 a Explain the results of natural selection in specialization, diversity, and adaptations.	Yes	1 2 3

Competency #7 **Describe the influence of one human body system on another as it relates to overall health.**		
7.1 Describe the influence of bacteria and/or viruses as they relate to overall human health.	Yes	1 2 3
7.2 Describe the influence of the endocrine system on reproduction and development and major disorders associated with each.	Yes	1 2 3
7.3 Identify normal functions and disorders associated with systems of the body to include nervous, circulatory, respiratory, muscular, and skeletal.	Yes	1 2 3
7.4 Identify drug categories and their effects on major systems of the human body.	Yes	1 2 3
Competency #8 **Explain how individual organisms and populations of organisms alter the environment.**		
8.1 Describe how non-human organisms can modify their environment (e.g., photosynthesis).	Yes	1 2 3
8.2 Describe methods of conserving renewable and non-renewable resources.	Yes	1 2 3
8.3 Define the major types of pollution as they relate to human's overall impact.	Yes	1 2 3
Competency #9 **Investigate the stability of ecosystems and identify cycle fluctuations.**		
9.1 Explain the biogeochemical cycles within an ecosystem.	Yes	1 2 3
9.2 Relate the stability of an ecosystem to its diversity.	Yes	1 2 3
9.2 a Describe the characteristics of major biomes.	Yes	1 2 3
Competency #10 **Relate the structure of biological molecules to their function in living organisms.**		
10.1 Explain the chemical composition of living systems including carbohydrates, proteins, enzymes, lipids, nucleic acids, and key inorganic compounds.	Yes	1 2 3
	Teach ?	**Emphasis on Assessment**
10.2 Compare and contrast the molecular structures of DNA and RNA as they relate to reproduction and protein synthesis.	Yes	1 2 3
Competency #11 **Explain how energy is transferred from one organism to another.**		
11.1 Explain how energy is transferred through trophic levels.	Yes	1 2 3
11.2 Examine the relationship between photosynthesis and respiration.	Yes	1 2 3
Competency #12 **Relate the use of modern biological techniques and methods of analysis to careers and real life situations.**		
12.1 Identify the uses of machines as aids and/or replacements for human organs or organ systems.	Yes	1 2 3
Competency #13 **Demonstrate the proper use and care for scientific equipment.**		
13.1 Demonstrate the proper use of microscopes, slide preparation techniques, metric measuring devices, and dissection tools.	Yes	1 2 3

Competency #14 **Observe and practice safe procedures in the classroom and laboratory.**		
14.1 Demonstrate knowledge of safety rules before working in the laboratory.	Yes	1 2 3
14.2 Model safety rules in all teacher demonstrations.	Yes	1 2 3
14.3 Demonstrate safe handling and disposal of chemicals.	Yes	1 2 3
14.4 Demonstrate safe handling of animals and disposal of dissection specimens.	Yes	1 2 3
14.5 Demonstrate appropriate personal safety and hygiene during laboratory activities.	Yes	1 2 3
Competency #15 **Integrate computers, calculators, and multimedia technology into classroom and laboratory activities.**		
15.1 Computers and/or probes may be used to simulate scientific processes.	Yes	1 2 3
15.2 Computers may be used to gather data and interpret graphs.	Yes	1 2 3
15.3 Calculators may be used when necessary to solve basic mathematical problems.	Yes	1 2 3
Competency #16 **Apply the components of scientific processes and methods in classroom and laboratory investigations.**		
16.1 Use process skills found within the scientific method such as prediction, observing, hypothesizing, gathering and interpreting data, and drawing conclusions.	Yes	1 2 3
Competency #17 **Investigate the interrelationships of science, technology, and society.**		
17.1 Illustrate how careers of community helpers relate to science.	Yes	1 2 3
17.2 Explore how scientific advances have changed cultures.	Yes	1 2 3
17.3 Examine ethical situations as they relate to scientific developments.	Yes	1 2 3
Competency #18 **Communicate results of scientific investigations in oral, written, and graphic form.**		
18.1 Prepare written laboratory reports and interpret the results of laboratory work through group or class discussion.	Yes	1 2 3
18.2 Organize and present data, charts, tables, and graphs in oral or written form.	Yes	1 2 3
Competency #19 **Research current scientific topics using resources in addition to the textbook.**		
19.1 Write original research papers or reports using age appropriate literature.	Yes	1 2 3
19.2 Have students demonstrate awareness of current scientific events through locating and sharing information from current age appropriate periodicals, magazines, newspapers, and electronic medial.	Yes	1 2 3

SUBJECT AREA TEST BLUEPRINT

The following blueprint identifies the six assessment strands that are tested in Biology I. Each strand has a specified number of questions that are to be used for assessment purposes. In addition to the specified number of questions, the blueprint identifies the competencies from the *2001 Mississippi Science Framework* that pertain to each assessment strand.

Blueprint Table

Assessment Strand drawn from competencies | **Number of multiple choice items per assessment strand** | **Competency with which assessment strand is aligned**

Assessment Strands	Number of Items	Competencies
Chemical Basis of Life	8	2 and 4
The Cell	15	3
Genetics and The Molecular Basis of Heredity	10	5
Natural Selection and Diversity	12	6
Ecology	10	7
Nature of Science	15	1

Total Number of Core (Scorable) Multiple-Choice Items	70*
Total Number of Core (Scorable) Open-ended Items	1*
Total Number of Field Test Multiple-choice Items	15**
Total Number of Field Test Open-ended Items	1**
Total Number of Test Items	87

*Students' scores will be based only on the 71 scored items. Only one open-ended item will count toward a student's score. It may appear in any strand in a given administration.
**The remaining 16 items are field test items embedded throughout the test. The number of field test items may vary across all assessment strands.

NOTE: *Field test items are* ***not*** *included in the student's score.*

BIOLOGY I

- one credit -

Biology I is an introductory, laboratory-based course designed to study living organisms and their physical environment. Students should apply scientific methods of inquiry and research in examination of the following topics: chemical basis of life; cell structure, function, and reproduction; energy; molecular basis of genetics; natural selection and diversity; and ecology.

The competencies are printed in bold face type and are required to be taught. Content strands include **Life Science**, **Physical Science** and **Earth and Space Science** competencies. Process Strands, which should be incorporated into all content strands are: **Unifying Concepts and Processes, Science as Inquiry, Science and Technology, Science in Personal and Social Perspectives, and the History and Nature of Science.** Emphasis is on developing the ability to ask questions, to observe, to experiment, to measure, to use computers and calculators, to problem solve/reason, to use tools of science, to gather data, and to communicate findings. The competencies may relate to one, many or all the science curriculum strands and may be combined and taught with other competencies throughout the school year. Competencies are not listed in order of importance, rather the sequence of competencies relates to the broader K-12 framework. Competencies provide a general guideline of ongoing instruction, not isolated units, activities or skills.

The suggested teaching objectives are optional. Objectives indicate concepts that enable the fulfillment of competencies, describe competencies in further detail, or show the progression of concepts throughout the grades. School districts may adopt or modify the objectives and are encouraged to write their own objectives to meet the needs of students in their school district. Through actively investigating and discussing scientific ideas using a variety of tools, students will become confident scientific thinkers.

The framework introduction, materials and equipment lists, technology and literature connections, and a glossary and reference section that are also a part of this document are available online at http://www.mde.k12.ms.us/acad/id/science.

BIOLOGY I

CONTENT STRANDS:
Life Science (L) *Earth and Space Science (E)*
Physical Science (P)

COMPETENCIES and Suggested Teaching Objectives:

1. Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation. (L, P, E)

a. Demonstrate the proper use and care for scientific equipment used in biology.
b. Observe and practice safe procedures in the classroom and laboratory.
c. Apply the components of scientific processes and methods in the classroom and laboratory investigations.
d. Communicate results of scientific investigations in oral, written, and graphic form.

2. Investigate the biochemical basis of life. (L, P)

a. Identify the characteristics of living things.
b. Describe and differentiate between covalent and ionic bonds using examples of each.
c. Describe the unique bonding and characteristics of water that makes it an essential component of living systems.
d. Classify solutions using the pH scale and relate the importance of pH to organism survival.
e. Compare the structure, properties and functions of carbohydrates, lipids, proteins and nucleic acids in living organisms.
f. Explain how enzymes work and identify factors that can affect enzyme action.

3. Investigate cell structures, functions, and methods of reproduction. (L)

a. Differentiate between prokaryotic and eukaryotic cells.
b. Distinguish between plant and animal (eukaryotic) cell structures.
c. Identify and describe the structure and basic functions of the major eukaryotic organelles.
d. Describe the way in which cells are organized in multicellular organisms.
e. Relate cell membrane structure to its function in passive and active transport.
f. Describe the main events in the cell cycle and cell mitosis including differences in plant and animal cell divisions.
g. Relate the importance of meiosis to sexual reproduction and the maintenance of chromosome number.
h. Identify and distinguish among forms of asexual and sexual reproduction.

4. Investigate the transfer of energy from the sun to living systems. (L, P)

a. Describe the structure of ATP and its importance in life processes.
b. Examine, compare, and contrast the basic processes of photosynthesis and cellular respiration.
c. Compare and contrast aerobic and anaerobic respiration.

5. Investigate the principles, mechanisms, and methodology of classical and molecular genetics. (L, P)

a. Compare and contrast the molecular structures of DNA and RNA as they relate to replication, transcription, and translation.
b. Identify and illustrate how changes in DNA cause mutations and evaluate the significance of these changes.
c. Analyze the applications of DNA technology (forensics, medicine, agriculture).
d. Discuss the significant contributions of well-known scientists to the historical progression of classical and molecular genetics.
e. Apply genetic principles to solve simple inheritance problems including monohybrid crosses, sex linkage, multiple alleles, incomplete dominance, and codominance.
f. Examine inheritance patterns using current technology (gel electrophoresis, pedigrees, karyotypes).

6. Investigate concepts of natural selection as they relate to diversity of life. (L)

a. Analyze how organisms are classified into a hierarchy of groups and subgroups based on similarities and differences.
b. Identify characteristics of kingdoms including monerans, protists, fungi, plants and animals.
c. Differentiate among major divisions of the plant and animal kingdoms (vascular/non-vascular; vertebrate/invertebrate).
d. Compare the structures and functions of viruses and bacteria relating their impact on other living organisms.
e. Identify evidence of change in species using fossils, DNA sequences, anatomical and physiological similarities, and embryology.
f. Analyze the results of natural selection in speciation, diversity, adaptation, behavior and extinction.

7. Investigate the interdependence and interactions that occur within an ecosystem. (L, P, E)

a. Analyze the flow of energy and matter through various cycles including carbon, oxygen, nitrogen and water cycles.
b. Interpret interactions among organisms in an ecosystem (producer/consumer/decomposer, predator/prey, symbiotic relationships and competitive relationships).
c. Compare variations, tolerances, and adaptations of plants and animals in major biomes.
d. Investigate and explain the transfer of energy in an ecosystem including food chains, food webs, and food pyramids.
e. Examine long and short-term changes to the environment as a result of natural events and human actions.

Process Strands:

Unifying Concepts And Processes	**Science As Inquiry**	**Science And Technology**	**Science In Personal And Social Perspectives**	**History And Nature Of Science**
Systems, order, and Organization Evidence, models, And explanation Change, constancy And measurement Evolution and Equilibrium Form and function	Abilities necessary to do scientific inquiry Understandings about scientific inquiry	Abilities of Technological Design Understandings about science and technology	Personal and community health Population growth Natural resources Environmental quality Natural and human-induced hazards Science and technology in local, national and global challenges	Science as a human endeavor Nature of scientific knowledge Historical perspectives

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Course: Biology I

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
1	a	Review laboratory equipment and uses with students; set up lab practical or measurement lab where they have to individually demonstrate proper use.	Performance assessment checklist
1	b	Review safety rules with students; watch lab safety video; complete safety contracts.	Performance assessment during year; quiz on safety
1	c	Let students design an original experiment using sponge animals and hot water, seed germination, etc. Also give students experiment scenarios and let them pick out variables, controls, write hypothesis, etc.	Teacher rubric Student responses Graded test
1	d	Let students collect data from experiments and summarize, graph, and present to class.	Rubric and checklist
2	a	Let students observe living and non-living things and write down characteristics of each.	Graded work
2	b	Let students draw or build models of each type of bond.	Graded work; Rubric
2	c	Model water molecule and demonstrate water properties using simple household materials, i.e., ice floating, drops of water on a penny, etc.	Graded work; evaluation questions from labs
2	d	Let students measure pH of household substances using pH paper and pH meter. Five drops of 0.1M HCl could be added to milk six times to show resistance of pH change (repeated with 0.1M NaOH). Conclusions: all living organisms must maintain constant pH to survive.	Chart of household substances and their pH measurements; Evaluation questions on buffer lab
2	e	Build paper models of organic compounds and summarize their properties and functions in living organisms. Run chemical tests identifying organic compounds.	Rubric Chart of test results

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
2	f	Prepare two test tubes, put small pieces of cooked liver in one and small pieces of fresh liver in the other. Add hydrogen peroxide to both tubes and observe the changes in each (temperature change and activity). Put small pieces of fresh pineapple vs. canned pineapple on gelatin, wait 30 minutes and observe.	Lab evaluation questions and summations
3	a	Construct models and compare drawings of the parts of the cell.	Write about differences
3	b	Build models of plant and animal cells or make colored drawings of cells.	Rubric; write about Differences
3	c	Construct chart of organelles and their function.	Rubric
3	d	Let students pick a system and investigate and identify the components of that system such as: digestive system, organ – stomach, tissues – connective covering (serosa), muscle layers, connective layer (submucosa), inner layer (mucosa). Mucosa layer is made up of columnar cells. Students could also do this for a plant.	Student work
3	e	Build models of cell membrane. Passive transport lab using an egg for cell or dialysis tubing and starch/iodine; egg white/water; glucose/water.	Rubric and evaluation Questions
3	f	Build pipe cleaner models of stages, observe slides of stages, role-play stages, use learning cycle cards.	Student work and evaluation Questions
3	g	Students can sequence a series of mitosis pictures (learning cycle cards) and describe what occurs in each view. (MS Biology Teachers Resource Guide)	Student work and evaluation Questions
3	h	Chart specific examples with advantages and disadvantages of sexual and asexual reproduction.	Student work
4	a	Model ATP from paper pieces, demonstrate how ATP forms ADP and rebuilds using a model.	Evaluation questions

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
4	b	Using large drawings of plant and animal cells, let students sequence where processes take place. For example, in mitochondria in both cells, let students place a number one for glycolysis outside the mitochondria and a number two for inside the mitochondria for pyruvic acid breakdown, number three for citric acid cycle and number four for electron transport chain, and so on.	Student work and evaluation Questions about processes
4	c	Construct chart listing differences in each process and how it occurs in different organisms.	Student work
5	a	Model building; protein synthesis games.	Rubric, student evaluation/ questions
5	b	Jelly genes. Students will change/delete steps in the instructions for making a peanut butter and jelly sandwich to show the effects mutations cause.	Teacher observation; analysis questions
5	c	Paper gene splicing; simulation of gel electrophoresis (MS Biology Teachers Resource Guide in Cell & Molecular Biology).	Student work; evaluation questions
5	d	Student reports and presentations; role-play; make historic timelines.	Rubric; teacher observation checklist
5	e	Build "reebops" and work problems with reebops, (MS Biology Teachers Resource Guide in Cell & Molecular Biology).	Student work
5	f	Karyotype lab; simulation of gel electrophoresis.	Student work; rubric on classroom presentations
6	a	Let students classify nuts and bolts, different shaped pasta, etc. and create their own dichotomous key.	Rubric
6	b	Make a model of each Kingdom using small paper critters glued down; list each Kingdom's unique characteristic.	Rubric
6	d	Bacteria general model with plastic bottle and string. Chart advantages and disadvantages of different types of bacteria. Do the same thing with viruses.	Rubric, student presentations

Comp.	Obj.	Suggested Teaching Strategies	Suggested Assessment
6	e	Compare fossils using a fossil kit; or bones using skeletons from different animals.	Evaluation questions
6	f	Students can act out food gathering differences with special adaptations, (i.e., tape fingers together and try to pick up peanuts (food), etc.	Evaluation questions; student writing about concept -- graded using rubric
7	a	Students will work in groups and present each cycle to the class.	Rubric; presentation Checklist
7	b	Competitive relationships can be demonstrated in food chain role-play activities.	Teacher observation
7	c	Let students build a biome in a box and draw an imaginary animal that could live in that biome explaining all adaptations that animal would need to survive.	Rubric; presentation; Student work
7	d	Food chain/web mobiles and/or food chain/web role play activities.	Student work; rubric
7	e	Germinate radish seeds in 10% soap solution, 1% soap solution, and distilled water. Make and record observations for five days.	Lab work; student Evaluations

Section III

Suggested Test Strategies

The Biology I Subject Area Test measures a student's knowledge of basic biological concepts, the use of science skills, and the application of biology to real-world problem solving and decision-making. Students will interpret data, apply concepts, draw conclusions, and explain their own ideas. The test consists of 85 multiple-choice items that may include charts, diagrams, or graphs, and two open-ended items. The open-ended items may require either a written or an illustrated response. Questions from the following assessment strands are distributed throughout the test: Chemical Basis of Life; The Cell; Genetics and The Molecular Basis of Heredity; Natural Selection and Diversity; Ecology; and Nature of Science.

FOR THE STUDENT

Suggested Test-Taking Strategies

•Read everything carefully –

Many of the Biology I SAT questions have tables, charts, graphs, diagrams, and experimental designs. ALL test questions require careful reading of the item stem; analysis of what the questions is asking, and attention to each of the four answer choices. Open-ended items may ask more than one question and should be analyzed carefully before constructing the appropriate response.

•Consider every choice –

In the multiple-choice section, a student must choose from four alternatives the BEST answer that addresses the question. Some of the alternatives (distractors) will look attractive because they may be similar to the correct answer. The student should rule out distractors because they will contain an irrelevant detail, a common misconception, or apply the right information in the wrong way. There will be one correct answer per question.

•Spend test time wisely –

Many test are arranged so that the easiest items are first and the hardest are last. The Mississippi Biology I Subject Area Test is NOT arranged this way. Questions are randomly arranged covering each competency throughout the test. Although the open-ended questions are placed at the end of the test booklet, they may be answered first. Many times a multiple-choice question may give you an idea that you wish to express in your open-ended response. It is perfectly acceptable to work at your own pace through the test in any order that you choose. If you do run into a few hard questions, move past these questions to those you know you can answer, then go back to the harder ones and reattempt to answer. Do NOT leave anything blank.

•Check your work –

Student carelessness can often cause incorrect answers. To avoid this, read the question carefully, read each answer choice, and choose the answer carefully. Another possibility for making mistakes is the transfer of the correct answer to the answer booklet. Keep asking yourself two questions: "Am I on the right question number in the answer booklet?" and "Is this the answer I meant to mark?"

•About written responses –

Open-ended items require students to supply their own answers. They require elaboration and assess higher order thinking skills. These items can have more than one correct answer and it is recommended that the student become familiar with the rubric and learn to self-assess their written work before the test. The student should read the open-ended scenario carefully and learn to mark, underline or number, each task that the question requires. It is good practice to outline the answer before writing. Write as neatly as possible and if you choose to draw a diagram to support the answer, make sure it is clearly labeled. Check to be sure that all parts of the question are answered and make sure the answer is clear and complete. Try to avoid redundancy, but support your answers. Reread the question and your answer before finishing. Do NOT leave anything blank.

FOR THE TEACHER

Preparing students for the test

1. The major job of the teacher is to make sure the local curriculum in Biology I is aligned with the state competencies found in the 2001 *Mississippi Science Framework.*
2. The teacher should carefully plan the sequence of topics to ensure that major concepts are introduced before the test date each year.
3. Work with the language arts teacher on student reading and writing skills. Ask students to write often in the biology classroom. Ask the students to score their own work and the work of others using rubrics similar to the one that will be used in the assessment.
4. Plan challenging instruction using a variety of sources. There are no perfect textbooks that magically "cover" the competencies found in the *Mississippi Science Framework*. Teachers should find activities that encourage thinking, problem solving, and writing about biology. Use cooperative learning groups often and let students design appropriate experiments to actually experience the scientific process.
5. Present each concept in multiple ways. Remember there are various learning styles represented in classrooms every day.
6. Create a test item bank of questions that encourage higher-level thinking. Incorporate practice test items and sample items into your weekly test. Ask higher order questions and ask the students to write test questions as a review strategy before each weekly test.
7. Review and practice before the test.
8. Convey your enthusiasm for the subject. Always be a positive academic "coach" for your students.

The Biology I Subject Area Test requires that students demonstrate an understanding of the material at three levels of cognitive thinking. The three cognitive levels on the test are based on learning expectations (what students should have learned and the skills they exercise to determine the correct answer), not item difficulty.

The levels are –

High: The student exercises thinking skills in that he/she must demonstrate a significant degree of interpretation, analysis, or application of information.

Medium: The student must demonstrate some degree of interpretation beyond recall of content information.

Low: The student must simply recall significant or important information from memory.

Analyzing a test question

The following terms describe the various components of a multiple choice item.

Stimulus – The art or referent that prompts a response.

Stem – The item stem actually states the problem. This can be posed as a question or as an incomplete statement.

Distractor – The incorrect answers to a multiple choice item.

Key - The correct choice to a multiple choice item.

Read the passage and answer the question that follows.

Weeds → Grasshopper → Robin → Snake → Hawk ← **Stimulus**

Which of the following will MOST likely happen if the robin population in the food web shown above decreases?

Stem

A The variety of weeds in the area will decrease. ← **Distractor**
B Competition among grasshoppers will increase. ← **Key**
C Parasites of grasshoppers will die out. ← **Distractor**
D Hawks will become grasshopper consumers. ← **Distractor**

Options

Suggested strategies for constructing or choosing multiple-choice questions

Exposure to a variety of types of multiple-choice questions is crucial to any student's success on the Biology I SAT. Multiple-choice items can cover a wide range of subject matter in a short period of time, but there are considerations when constructing or choosing these items.

1. With respect to the item as a whole, consider whether:
    a. the item tests knowledge of a skill that is worthwhile and appropriate for the intended test population.
    b. there is a significantly better way to measure what the item tests.
    c. the item is within the appropriate range of difficulty for the intended test population.

2. With respect to the stem, consider whether the item:
    a. poses a clearly defined problem or task
    b. contains unnecessary information.
    c. be worded more clearly or concisely.

3. With respect to the options (includes key and distractors), consider whether:
    a. they are reasonably parallel in structure.
    b. they fit logically and grammatically with the stem.
    c. they can be worded more clearly or concisely.
    d. any are so inclusive that they logically eliminate another more restricted option from being the unique key.

When using tests written by others

4. With respect to the key (best answer), determine:
    a. which option you think is intended to be the correct response. (In cases where the item writer has actually marked the key, verify that your choice agrees with his or hers.)
    b. whether the key actually answers the question posed.
    c. whether the key needs to be made less obvious in relation to the other options or the stem.

5. With respect to the distractors, consider whether:
    a. there is any possible justification for considering one of them as an acceptable response to the question.
    b. they are sufficiently plausible to attract students who are misinformed or inadequately prepared. (The distractors must not be a set of irrelevant responses.)
    c. any of them unnecessarily calls attention to the key. For example, no option should simply state the opposite of the key or, conversely, resemble the key very closely, unless another pair of options involves similar opposition or parallelism.

Sample multiple-choice items:

1. Make sure the item asks the student for more than rote memory.

Poor

Which of these organelles is most responsible for energy production in the cell?

A. Mitochondria *
B. Nucleus
C. Ribosomes
D. Golgi bodies

Better

Which of these cells would probably have the MOST mitochondria?

A. Muscle *
B. Fat
C. Nerve
D. Bone

2. Make sure the item matches the competency and is appropriate for the student population.

Competency: Observe and practice safe procedures in the classroom and laboratory.

Poor

Which of these is MOST effective in killing bacteria in an agar filled Petri dish?

A. Exposing the plates to sunlight for 10 minutes.
B. Boiling the plates for 5 minutes.
C. Cooking the plates in a pressure cooker for 15 minutes. *
D. Bathing the plates in distilled water for 3 minutes.

Better

While heating a test tube, it is important to –

A. make sure the liquid level is at the top of the test tube.
B. make sure the test tube is pointed away from people. *
C. keep the test tube perfectly still while it is being heated.
D. heat the bottom tip of the test tube.

2. Make sure the item has only one correct answer. In the "poor" example below, all the answer choices (a, b, c, or d) could be correct.

Poor

Which of the following is an example of an omnivorous animal?

A. A rat
B. A bear
C. A human •
D. A pig ?

Better

Which of the following is an example of an omnivorous animal?

A. A cow
B. A horse
C. A human •
D. A sheep

Guidelines for constructing or choosing open-ended items

In choosing or constructing open-ended items, the following characteristics should be considered.

1. With respect to the question or task, consider whether:
   a. the question or task assesses meaningful outcomes.
   b. the open-ended response mode is the most appropriate way to measure the stated objective(s).
   c. the question or task is of appropriate difficulty for the target population.

2. With respect to the statement of the question or task, consider whether it:
   a. poses a clearly defined problem.
   b. contains all necessary information.
   c. can be worded more clearly or concisely.

3. With respect to the scoring rubrics provided with the questions or tasks, consider whether:
   a. the anticipated responses can be delineated according to the intended number of score points (e.g., 0-4 or 1-5).
   b. the rubrics are inclusive and flexible enough to apply to a wide range of anticipated responses.

The following are examples of questions that are NOT open-ended items.

- What structure is the "powerhouse" of the cell?
- How many chromosomes does a human skin cell have?
- Who invented the microscope?

These items only require one-word responses and are not formatted for scoring using an open-ended rubric.

The following is an example of a more appropriate open-ended item.

A gardener planted some purebred tall pea plants in a large garden. Most of the plants grew tall. However, at one end of the garden the plants were shorter than the other plants. Explain what might have caused these plants to be short and how this would affect the offspring of these shorter plants.

What is this question asking the student to do?

1. Explain what might have caused the plants to be short.
2. How would this affect offspring of the shorter plants?

To obtain full credit for this question, the student should answer BOTH questions correctly, completely, and use appropriate supporting facts and details. They should thoroughly address the concept and make sure both answers are clearly focused, well organized and shows understanding of genetics.

Scoring Open-Ended Items

Mississippi Subject Area Testing Program - Biology I
Rubric for Open-Ended Items

Student responses to open-ended items receive a score of 0, 1, 2, 3, or 4, based on the following general rubric:

4 The student response
- provides a complete interpretation or solution.
- is correct and all supporting facts and observations are accurate.
- meets all problem requirements.
- thoroughly addresses issues relevant to the concept, but may contain minor inaccuracies or irrelevant information that does not detract from the overall quality of the response.
- is clearly focused, well-organized, and shows an understanding of all components of the issue or process.
- contains sufficient detail to convey thorough understanding.

3 The student response
- provides an adequate interpretation or solution.
- incorporates accurate facts and observations relevant to the concept but may contain minor errors that do detract from the overall quality of the response.
- is clearly focused, well organized, but fails to show a full understanding of all components of the issue or process.
- lacks significant detail to convey thorough understanding.

2 The student response
- provides a partial interpretation or solution.
- is incomplete, with few supporting facts or observations indicating little understanding of the issue or process.
- partially addresses issues relevant to the concept with significant errors that detract from the overall quality of the response.
- provides some evidence of reasoning but there are gaps in focus and organization.
- offers weak supporting detail that conveys limited understanding.

1 The student response
- provides a vague interpretation or solution, indicating minimal understanding of the issue or process.
- attempts to address issues relevant to the concept, but includes numerous errors that significantly detract from the overall quality of the response.
- offers little or no supporting detail that conveys limited understanding.

0 The student response

- indicates no understanding of the issue or process, evidenced by incomplete or inaccurate work.
- does not address the problem.
- is off-topic.
- is written in a foreign language.
- is written illegibly.
- is a copy of the item.
- is a refusal to respond.
- is blank.
- is incomprehensible.

Common errors in written responses

1. **Misinterpretation of the question(s) -**
   Most students may not read the questions completely or may not understand what the question is asking.
2. **Poor organization of response -**
   Students may not organize their responses in a way that answers the question. Because of the poor paragraph organization, students could exclude information they may know. Constructing an outline first may help with this problem.
3. **Lack of clarity and conciseness -**
   Many students "beat around the bush" when answering questions that they do not feel comfortable answering. Even students who understand the question and know the appropriate response may meander around the answer instead of getting to the point. Providing examples and discussing this problem may help students to avoid it.
4. **Common grammatical errors -**
   Lack of capitalization, misplaced commas, run on sentences, creation of unneeded paragraphs, and misspelled words are not cause to take away points from the student response. However, a well written response with few grammatical errors is something every student should strive to achieve in the open-ended section.
5. **Answering incompletely -**
   Most open-ended items ask the student more than one question. Many students only answer the last question or the first question. Students need to understand that in order to obtain full credit for their responses they must provide a complete interpretation or solution.

Terminology

Most standardized tests utilize certain terminology with which the student should become familiar. Examples of this terminology are:

Analyze – to break down, in order to understand the relationship or individual parts.

Assess – estimate the value or significance of something.

Bias - a subjective point of view, as bias in favor of or against an idea.

Characterize – to depict or give the distinguishing trait of something.

Classify - to group according to relationships, to categorize.

Compare - to point out similarities and differences between objects with the emphasis on similarities.

Contrast – to stress differences between objects.

Define – to give a clear concise meaning for a term. Generally, it consists of identifying the class to which a term belongs, and how it differs from other things in that class.

Discuss – to treat a subject fully, providing background information and explaining how parts relate to each other.

Evaluate – to make a value judgment with a statement of negative and or positive worth.

Illustrate – to make clear by use of examples or visual features.

Identify – to distinguish one or more things or people from a larger number.

Summarize – to reduce by citing main points relevant to an issue in condensed, abbreviated form with details, illustrations, and examples omitted.

Valid – a statement or term that is most correct or appropriate for the content.

Guidelines for Item Writing

1. Does the item match the competency?
2. Does the item ask the student for more than rote memory?
3. Is the question tricky?
4. Can a student correctly answer the question without actually reading the question?
5. Is the question clearly stated?
6. Is vocabulary and reading level appropriate?

Guidelines for Test Construction

1. Does the test cover all of the competencies that have been taught?
2. Does the test content reflect the weight given to various topics?
3. Is the reading level appropriate? Is the vocabulary of test questions generally no higher than 8^{th} grade?
4. Are there test items that reflect new ways to look at the information being taught?
5. Are there a variety of item types on the test?
6. Does one item on the test give away the answer to another item on the test?

Section IV

Additional Teaching Strategies with Sample Assessment Items

Competency 1: Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

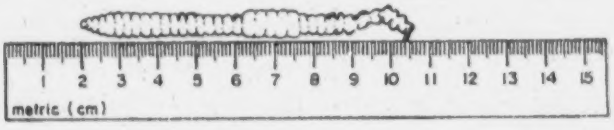
ASSESSMENT STRAND: NATURE OF SCIENCE

Objective 1a. Demonstrate the proper use and care for scientific equipment used in biology.

Teaching Strategies:

- Review laboratory equipment and uses with students. Let them label a worksheet detailing each piece of equipment and describe how each is used.
- Set up lab practical or measurement lab where the students have to demonstrate individually proper use of balances, rulers, thermometers, etc.
- Set up a performance assessment where each student demonstrates proper microscope use.

Sample Test Item:



A student wrote in his/her lab notebook that the earthworm was 8.5 cm long. This is incorrect because the earthworm

A cannot grow longer than 7.5 cm
B should be measured when it is contracted
C should have been measured in inches.
D is actually longer than 8.5 cm. •

Competency 1: Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

ASSESSMENT STRAND: NATURE OF SCIENCE

Objective 1b. Observe and practice safe procedures in the classroom and laboratory.

Teaching Strategies:

- Review safety rules with students. Give them a quiz on the rules.
- Watch lab safety video.
- Complete safety contracts.

Sample Test Item:

Which of the following should NEVER take place in a lab?

A Cleaning glassware
B Tasting a chemical *
C Tying back long hair
D Wearing safety glasses

During a laboratory exercise, a student bumped the table where chemicals were being held. The storage containers tumbled over, and the different liquids spilled onto the table. What is the FIRST thing that other students should immediately do?

A Wipe up the liquid with paper towels.
B Set the containers upright.
C Dilute the spill with water.
D Tell the teacher what has happened. *

Competency 1: Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

ASSESSMENT STRAND: NATURE OF SCIENCE

Objective 1c. Apply the components of scientific processes and methods in the classroom and laboratory investigations.

Teaching Strategies:

- Let students design an original experiment using seeds, sponge animals, yeast and honey, etc.
- Give students experiment scenarios and let them write an appropriate hypothesis and pick out variables.

Sample Test Item:

A biology student wondered if music had an effect on plant growth. Twenty-five corn plants were placed in a chamber where music was played and twenty-five corn plants were placed in an identical chamber where music was not played. The growth chambers were kept at the same temperature and all plants received the same amount of sunlight, fertilizer and water. At the end of 3 weeks, plant height was measured.

Which of the following would be the independent variable in this experiment?

A Temperature
B Plant growth
C Sunlight
D Music *

Which of the following would be the dependent variable in this experiment?

A Temperature
B Plant growth *
C Sunlight
D Music

Competency 1: Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.

ASSESSMENT STRAND: NATURE OF SCIENCE

Objective 1d. Communicate results of scientific investigations in oral, written, and graphic form.

Teaching strategies:

- Let students collect data from experiments and summarize, graph, and present to class.
- Use a "M & M" lab where students construct bar, line and pie graphs from a small bag of colored candy.

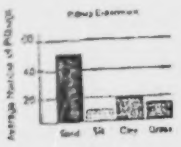
Sample Test Items:

Number of Pill Bugs

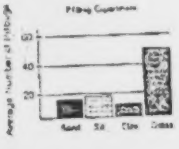
	Sand	Silt	Clay	Grass
Total 1	23	13	10	52
Total 2	17	13	8	65
Total 3	19	27	12	59
Total 4	12	25	15	49
TOTAL	64	78	43	219
AVERAGE	16.0	19.5	10.7	55.7

The chart above shows the results of an experiment designed to determine the most likely area in which to find pill bugs. Which graph is the BEST representation of these data?

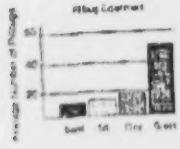
A



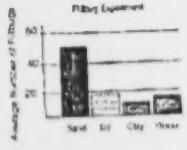
C



B



D



During a survey of the fish population in a small pond biologists counted a total of 100 fish. According to the graph, about how many minnows were counted in this sample?

A 10
B 25 *
C 50
D 75

Competency 2: Investigate the biochemical basis of life.

ASSESSMENT STRAND: CHEMICAL BASIS OF LIFE

Objective 2a. Identify the characteristics of living things.

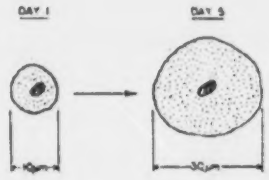
Teaching Strategies:

- Let students observe living and non-living things. Write down the characteristics of each item as they observe.
- Divide the students into cooperative learning groups and assign each group one characteristic of life. Let them find several pictures in magazines that show evidence of their assigned characteristic. Let each groups present their findings to the class.

Sample Test Item:

Which life activity is illustrated by the diagram?

A reproduction
B excretion
C transport
D growth *



Which life activity is NOT essential to the maintenance of an individual organism?

A Absorption
B Excretion
C Reproduction *
D Homeostasis

Competency 2: Investigate the biochemical basis of life.

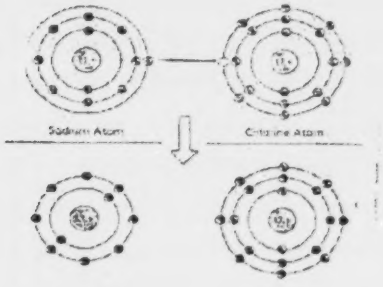
ASSESSMENT STRAND: CHEMICAL BASIS OF LIFE

Objective 2b. Describe and differentiate between covalent and ionic bonds using examples of each.

Teaching Strategies:

- Let students draw or build models of each type of bond.
- Give students worksheets showing different bond formations occurring. Let them label as to ionic and covalent and explain their reasoning.

Sample Test Item:



The type of chemical bonding shown in the diagram represents

A Polar covalent
B Non-polar covalent
C Hydrogen
D Ionic *

Competency 2: Investigate the biochemical basis of life.

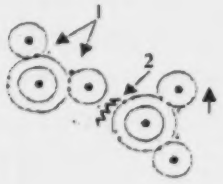
ASSESSMENT STRAND: CHEMCIAL BASIS OF LIFE

Objective 2c. Describe the unique bonding and characteristics of water that make it an essential component of living systems.

Teaching Strategies:

- Let students construct water molecules from gum drops and toothpicks. Discuss differences between hydrogen bonding and the polar covalent bonds holding the molecule together.
- Demonstrate water properties using simple household materials, i.e., ice floating in clear container.
- Let students predict how many drops of water a penny can hold. Let them actually carry out experiment. Dry the penny, add a drop of soap solution to the penny and repeat the experiment. Discuss how the soap breaks the hydrogen bonding between the water molecules.

Sample Test Items:



In the water molecule, two different types of bonding are illustrated. The bond represented by label 1 is MOST responsible for the ability of water to

A demonstrate non-polar behavior
B dissolve non-polar substances
C demonstrate polar behavior *
D contract when it freezes

Some insects can stand on the surface of water because water

A has a high specific heat
B has a high boiling point
C is a good evaporative coolant
D is cohesive and adhesive *

Competency 2: Investigate the biochemical basis of life.

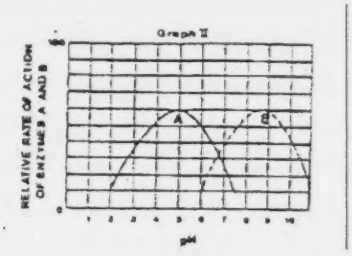
ASSESSMENT STRAND: CHEMICAL BASIS OF LIFE

Objective 2d. Classify solutions using the pH scale and relate the importance of pH to organism survival.

Teaching Strategies:

- Let students measure pH of household substances using pH paper and/or pH meter.
- Take the pH of milk. Add 5 drops of 0.1 M HCl to milk, stir and record pH. Repeat 6 times. This will show students how a living organism must resist pH changes to survive. This can be repeated with 0.1 M NaOH.

Sample Test Item:



The optimum environment for enzyme B is

A a basic medium *
B an acidic medium
C a neutral medium
D both an acid and a basic medium

Which pH indicates the strongest basic solution?

A 3.5
B 6.4
C 10.0
D 12.9 *

Competency 2: Investigate the biochemical basis of life.

ASSESSMENT STRAND: CHEMICAL BASIS OF LIFE

Objective 2e. Compare the structure, properties and functions of carbohydrates, lipids, proteins and nucleic acids in living organisms.

Teaching Strategies:

- Build paper models of organic compounds and summarize their properties and functions below the model.
- Run chemical tests using iodine, Benedict's solution, Biuret solution, Sudan IV, to identify organic compounds in foods.

Sample Test Item:

Which of the following is NOT a carbohydrate?

A Cellulose
B Lipids *
C Monosaccharides
D Starch

Which biological molecule composes chromosomes?

A Glucose
B Carbohydrates
C Nucleic acids *
D Phospholipids

The glucose produced during photosynthesis is an example of a –

A lipid.
B protein.
C nucleic acid.
D monosaccharide. *

Competency 2: Investigate the biochemical basis of life.

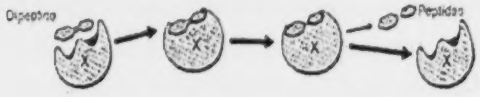
ASSESSMENT STRAND: CHEMICAL BASIS OF LIFE

Objective 2f. Explain how enzymes work and identify factors that can affect enzyme action.

Teaching Strategies

- Prepare two test tubes, put small pieces of cooked liver in one and small pieces of fresh liver in the other. Add hydrogen peroxide to both tubes and observe the changes in each (temperature change and activity). The cooked liver enzymes had been denatured by the cooking process and would not react with the hydrogen peroxide.
- Put small pieces of fresh pineapple vs. canned pineapple on gelatin, wait 30 minutes and observe. The canned pineapple's enzymes have been altered by the heat in the canning process. It will not break down the gelatin like the raw pineapple will.

Sample Test Item:



In the diagram above, the substance labeled X is MOST likely

A an enzyme *
B water
C ATP
D oxygen

Competency 3: Investigate cell structures, functions, and methods of reproduction.

ASSESSMENT STRAND: THE CELL

Objective 3a. Differentiate between prokaryotic and eukaryotic cells.

Teaching Strategies:

- Give the students diagrams of a prokaryote and eukaryotic cell. Ask them to compare the two cells and write 1 paragraph about how they are similar and how they are different.
- Let the students make models of a prokaryote and eukaryotic cell.

Sample Test Items:

A student observes one-celled organisms with cilia, organelles, and a nucleus. The cell type would be

A fungal
B eukaryote *
C prokaryote
D multicellular

Which of the following organisms is prokaryotic?

A Yeast
B Euglena
C Bacteria *
D Mushroom

Competency 3: Investigate cell structures, functions, and methods of reproduction.

ASSESSMENT STRAND: THE CELL

Objective 3b. Distinguish between plant and animal (eukaryotic) cell structures.

Teaching Strategies:

- Let the students color pictures of plant and animal cells. Ask them to label each cell and write a paragraph explaining the differences between the two cells.
- Let students build models of plant and animal cells. Let them present their models to the class.

Sample Test Items:

Using a microscope, a biology student observes a cell containing a nucleus, cell wall, and chloroplasts. The student is observing a

A plant cell *
B animal cell
C fungal cell
D prokaryote cell

Which structure is found ONLY in animal cells?

A chloroplast
B centrioles *
C mitochondria
D microtubules

Competency 3: Investigate cell structures, functions, and methods of reproduction.

ASSESSMENT STRAND: THE CELL

Objective 3c. Identify and describe the structure and basic functions of the major eukaryotic organelles.

Teaching Strategies:

- Let the students construct a chart showing the eukaryotic cell organelles and their function.
- Let the students write an original analogy comparing the organelle function to a household structure, appliance, etc.

Sample Test Items:

The building of proteins from amino acids occurs on the cell's -

A membrane.
B ribosomes. *
C nucleus.
D centriole.

A cell that has many mitochondria would produce a great deal of

A protein
B energy *
C enzymes
D cytoplasm

Competency 3: Investigate cell structures, functions, and methods of reproduction.

ASSESSMENT STRAND: THE CELL

Objective 3d. Describe the way in which cells are organized in multicellular organisms.

Teaching Strategies:

- Let students pick a system and investigate and identify the components of that system, i.e., system - digestive; organ - stomach; tissues - connective, muscle, epithelial, nervous; cells – simple columnar epithelial in stomach lining. Explain to the students how similar cells form a tissue; tissues working together form an organ; organs working together form a system.
- Let students pick another system, perhaps from a plant, and perform the same activity with the teacher's help.

Sample Test Items:

Which of the following four levels of organization includes the other three?

A Organ
B System *
C Cell
D Tissue

Which level of organization is more complex than a system?

A Cell
B Tissue
C Organ
D Organism *

Competency 3: Investigate cell structures, functions, and methods of reproduction.

ASSESSMENT STRAND: THE CELL

Objective 3e. Relate cell membrane structure to its function in passive and active transport.

Teaching Strategies:

- Describe the fluid mosaic model to the students. Ask them to make a model of the cell membrane and label each component.
- Demonstrate diffusion of glucose across dialysis tubing by placing a glucose solution inside a dialysis tubing "bag." Place distilled water outside the bag in a beaker. Test the solution outside the bag with Benedict's solution the next day for the presence of glucose.
- Demonstrate that all things will not pass through a membrane by using a starch solution inside a sandwich bag. Tie the bag with string and place in an iodine solution. The solution inside the bag will turn blue-black after a period of time because the iodine was smaller than the pores in the bag. Starch will not diffuse out of the bag because it is too large.

Sample Test Items:

The diffusion of a substance into or out of a cell requires -

A a concentration gradient. *
B an active transport system.
C a carrier molecule.
D a functioning mitochondrion.

The part of a eukaryotic cell that allows it to remain separate from the outside environment is the -

A cell membrane. *
B ribosome.
C cytoplasm.
D Golgi vesicle.

Which of the following substances enters the cell using active transport?

A water molecules
B oxygen molecules
C phosphate ions *
D carbon dioxide

Competency 3: Investigate cell structures, functions, and methods of reproduction.

ASSESSMENT STRAND: THE CELL

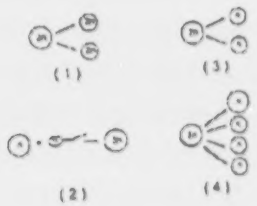
Objective 3f. Describe the main events in the cell cycle and cell mitosis including differences in plant and animal cell divisions.

Teaching Strategies:

- Give the students a zip lock bag with twisted pipe cleaners representing a fly nucleus (8 chromosomes that have been "doubled" and twisted). Let the students work in groups to model each stage of mitosis.
- Let students make a poster showing the stages of mitosis. Label each stage and summarize the process below each stage.
- Students can represent chromosomes by wearing a sign. Two students can pair up to be a duplicated chromosome. Let groups of four to five students act out the process of mitosis. Let the student chromosomes hold yarn to represent the spindle. Extra students can represent the cell membrane and/or cell plate.
- Learning cycle cards (cards that show different phases of the cell cycle) could be given mixed up to a group of students. They can sequence the cards and describe the stages of mitosis.
- Students can observe the phases of mitosis on a prepared microscope slide of plant cells and animal cells.

Sample Test Items:

Which diagram represents mitotic cell division?



The normal diploid chromosome number of a mouse is 40. How many chromosomes would be found in a skin cell of this mouse after mitosis?

A 10
B 20
C 30
D 40 *

Competency 3: Investigate cell structures, functions, and methods of reproduction.

ASSESSMENT STRAND: THE CELL

Objective 3g. Relate the importance of meiosis to sexual reproduction and the maintenance of chromosome number.

Teaching Strategies:

- Students can observe a "mini movie" showing the process of mitosis and meiosis. Differences can be discussed after the film.
- Students can act out the process of meiosis. Similar socks of different colors or colored paper could be held to represent homologous chromosomes. Synapsis and crossing over could be demonstrated using the students.
- Students can sequence a series of meiosis learning cycle cards and describe what occurs in each view.

Sample Test Items:

The cells of the white oak, *Quercus alba* , contain 24 chromosomes. After meiosis is complete, how many chromosomes are in the new cells?

A 12 *
B 20
C 24
D 48

The number of chromosomes in the egg cell of a potato plant is 24. The number of chromosomes in the cells found in the potato root tissue would be –

A 12
B 24
C 36
D 48 *

Competency 3: Investigate cell structures, functions, and methods of reproduction.

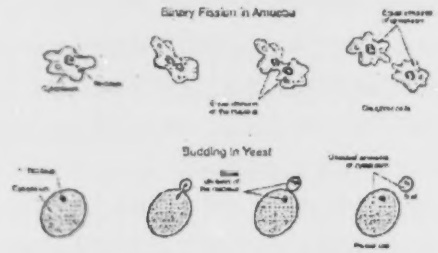
ASSESSMENT STRAND: THE CELL

Objective 3h. Identify and distinguish among forms of asexual and sexual reproduction.

Teaching Strategies:

- Ask students to bring in examples of plant material capable of vegetative reproduction and begin to propagate them in the classroom. Emphasize the fact that the "new" plant will be genetically the same as the original plant.
- Demonstrate conjugation in bacteria by using two different colored yarn pieces for two different bacteria's DNA. Show how passing sections of the DNA from one cell to another will alter the genetic makeup of the organisms.
- Let students chart specific examples of advantages and disadvantages with sexual and asexual methods of reproduction.

Sample Test Items:



According to this information, binary fission and budding are both methods of –

A asexual reproduction *
B waste removal
C cytoplasm reduction
D cellular repair

Competency 4: Investigate the transfer of energy from the sun to living systems.

ASSESSMENT STRAND: CHEMICAL BASIS OF LIFE

Objective 4a. Describe the structure of ATP and its importance in life processes.

Teaching strategies:

- Make a model of ATP from colored paper (1 piece adenosine, 3 circles representing phosphate, and a "lightening bolt" labeled high energy bond). Using the model let students demonstrate how ATP forms ADP and releases energy in the process.
- Let the students use the model to demonstrate how ADP can store energy and reform ATP.
- Use analogies to discuss the importance of ATP to cellular processes. An example could be: ATP is to the cell what gasoline is to an automobile. Also let the students compare buying a candy bar with a $100 dollar bill vs. a 1.00 bill. Explain that is why ATP needs to be made in small amounts so it can be utilized quickly for all cellular energy needs.

Sample test items:

The source of an organism's cellular energy (ATP) comes from -

A carbon dioxide
B enzymes
C food *
D water

Cells release energy when

A a phosphate attaches to ADP
B a phosphate breaks away from ATP *
C cells release waste
D cells break down sucrose to glucose and fructose

Competency 4: Investigate the transfer of energy from the sun to living systems.

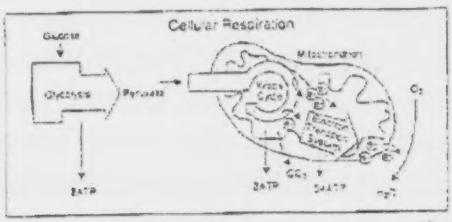
ASSESSMENT STRAND: CHEMICAL BASIS OF LIFE

Objective 4b. Examine, compare, and contrast the basic processes of photosynthesis and cellular respiration.

Teaching Strategies:

- Let the students write word equations for photosynthesis. Discuss the light reactions and the Calvin cycle. Let the students label which reactant and product was used/produced in the light process and which was used/produced in the Calvin cycle.
- Write the equations for photosynthesis and respiration on the board. Ask students to explain the relationship between the processes.
- Using a large drawing of an animal and plant cells, let the students sequence where the process of photosynthesis and respiration would take place. Point out that both plant and animal cells contain mitochondria and the process of cellular respiration takes place in both cells.
- Diagram a large mitochondria on the board. Let the students sequence and briefly describe where each stage of cellular respiration would occur.

Sample Test Items:



The diagram shows some of the stages in cellular respiration. Which of the following gives the stages in the correct order?

A Electron transport system, Krebs cycle, glycolysis
B Glycolysis, electron transport system, Krebs cycle
C Krebs cycle, glycolysis, electron transport system
D Glycolysis, Krebs cycle, electron transport system *

What are the major products of photosynthesis?

A Oxygen and water
B Oxygen and glucose *
C Carbon dioxide and oxygen
D Carbon dioxide and water

Competency 4: Investigate the transfer of energy from the sun to living systems.

ASSESSMENT STRAND: CHEMICAL BASIS OF LIFE

Objective 4c. Compare and contrast aerobic and anaerobic respiration.

Teaching Strategies:

- Write the terms aerobic and anaerobic respiration on the board. Let the students define each one. List the major similarities and differences. Point out that both processes begin the same way. Compare energy produced in each process.
- Define fermentation and discuss how this is performed by yeast in the process of bread making. Discuss lactic acid fermentation in human muscle cells.

Sample Test Items:

Which of the following processes occurs in both aerobic and anaerobic respiration?

A Electron transport chain
B Krebs cycle
C Pyruvic acid breakdown
D Glycolysis *

Competency 5: Investigate the principles, mechanisms, and methodology of classical and molecular genetics.

ASSESSMENT STRAND: GENETICS & MOLECULAR BASIS OF HEREDITY

Objective 5a. Compare and contrast the molecular structures of DNA and RNA as they relate to replication, transcription, and translation.

Teaching Strategies:

- Let the students build models of DNA and RNA to compare the differences in structures.
- Let the students color and cut out paper models of DNA and RNA. They can use these models to simulate the process of replication and transcription.
- Hang amino acid names printed on construction paper around the room. Let the students represent tRNA anticodons. When you call out the mRNA codon code, let the "matching anticodon" student pick up the appropriate amino acid and bring it to the wall marked ribosome in the room. This process will stimulate translation.
- Let students practice taking DNA sequences and going through the central dogma process. Let them first write the complementary DNA strand, then the mRNA strand, and finally using a RNA codon chart the appropriate sequence of amino acids this original strand of DNA would code.

Sample Test Items:

Which base sequence will complete this section of DNA?

A CATCCG *
B ATAGGC
C AGTCCT
D TCGAAG

Messenger RNA Codon	Amino Acid
AGA	Arginine
CUA	Leucine
GGC	Glycine
UUC	Phenylalanine

What would the RNA sequence be for the following protein sequence?

glycine – leucine – arginine

A GGC CUA AGA *
B UUC CUA GGC
C CCG GAT TCT
D GGC GAT TCT

Competency 5: Investigate the principles, mechanisms, and methodology of classical and molecular genetics.

ASSESSMENT STRAND: GENETICS & MOLECULAR BASIS OF HEREDITY

Objective 5b. Identify and illustrate how changes in DNA cause mutations and evaluate the significance of these changes.

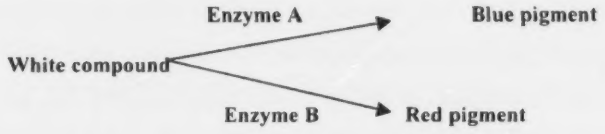
Teaching Strategies:

- Let students sequence DNA strands to RNA and then to proteins. Change the DNA strand and let them work through the process again. Delete a codon and then alter one base and let the students see how frameshift mutations and point mutations occur.
- Students can play the jelly gene game found on the Woodrow Wilson web site. They try to build a peanut butter and jelly sandwich by listening to the teacher call out instructions. One student will perform one task. The first series of instructions will build a complete sandwich correctly. Other instructions will show "mutated" instructions. Students will understand how incorrect information can alter the cell's products.

Sample Test Items:

Flies are made up of hundreds of cells that replace themselves with very few mutations. However, if a mutation was passed to the flies' offspring, what type of cell did it occur in?

A Nerve
B Skin
C Sperm *
D Muscle



In a certain plant the flower petals are normally purple if both enzyme A and enzyme B are produced. If a mutation occurred that stopped production of only enzyme B, what color petals would be produced?

A Red
B Blue *
C White
D Purple

Competency 5: Investigate the principles, mechanisms, and methodology of classical and molecular genetics.

ASSESSMENT STRAND: GENETICS & MOLECULAR BASIS OF HEREDITY

Objective 5c. Analyze the applications of DNA technology (forensics, medicine, agriculture).

Teaching Strategies:

- Let students perform a "paper gene splicing" activity. They can be found at the Access Excellence web site (www.accessexcellence.org), or the *Mississippi Cell and Molecular Biology Resource Guide.*
- Let students research articles about altering genes in products. They can write a summary of the article that they research and write an opinion to the technology involved in the article. They can present their articles to the rest of the class for discussion.

Sample Test Items:

***Bacillus thuringiensis,* commonly known as Bt, produces a protein that can kill certain insects that feed on corn crops. Scientists have successfully genetically engineered this gene into corn. The corn's pest, the corn borer, will die when they try to eat leaves from Bt corn. A potential problem with increased Bt use would be**

A cost of technology increasing.
B corn borers developing resistance to Bt corn. *
C soil being damaged due to genetic alteration of plants.
D cost of farmers buying machinery to keep up with demand.

Competency 5: Investigate the principles, mechanisms, and methodology of classical and molecular genetics.

ASSESSMENT STRAND: GENETICS & MOLECULAR BASIS OF HEREDITY

Objective 5d. Discuss the significant contributions of well-known scientists to the historical progression of classical and molecular genetics.

Teaching Strategies:

- List major scientists and let students research their contributions to modern genetics. Students can make oral reports to the class.
- Let students make a time-line demonstration major discoveries in the field of molecular biology and classical genetics.

Sample Test Item:

Which scientists are credited with the discovery of the structure of the DNA molecule?

A Jenner and Pasteur
B Watson and Crick *
C Hershey and Chase
D Mendel and Redi

Competency 5: Investigate the principles, mechanisms, and methodology of classical and molecular genetics.

ASSESSMENT STRAND: GENETICS & MOLECULAR BASIS OF HEREDITY

Objective 5e. Apply genetic principles to solve simple inheritance problems including monohybrid crosses, sex linkage, multiple alleles, incomplete dominance, and codominance.

Teaching Strategies:

Let students begin their study by building "reebop" organisms. Instructions for reebops can be found in the *Mississippi Cell and Molecular Biology Resource Guide* and also at the Access Excellence web site (www.accessexcellence.org). Go to the search engine and type in rebop, not reebop.

Give the students genetic problems in cooperative learning groups. Let the groups put their problems on the board and explain it to the rest of the class.

Let the students flip coins and "build a baby" based on traits. This activity can be found in the Tech Prep *Cord* Books.

Another activity is "Dropping Your Genes" found in the *Mississippi Cell and Molecular Biology Resource Guide.*

Sample Test Items:

If two people who can roll their tongues(R) marry and have a child who cannot roll his/her tongue (r), what are the genotypes of the parents?

A RR x RR
B Rr x Rr *
C rr x rr
D RR x rr

In humans, the gene for normal blood clotting, H, is dominant to the gene for hemophilia, h. The trait is sex-linked. What are the chances that a man (X^HY) and a woman (X^HX^h) will have a child with hemophilia?

A 25% *
B 50%
C 75%
D 100%

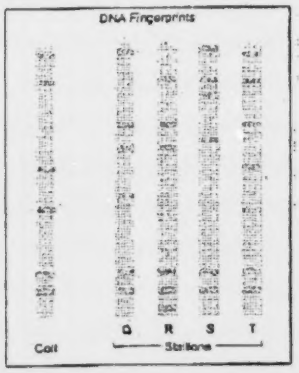
Competency 5: Investigate the principles, mechanisms, and methodology of classical and molecular genetics.

ASSESSMENT STRAND: GENETICS & MOLECULAR BASIS OF HEREDITY

Objective 5f. Examine inheritance patterns using current technology (gel electrophoresis, pedigrees, karyotypes).

Teaching Strategies:

- Let students work karyotype activities for sex determination and genetic disorders. Sample activities can be found in the *Mississippi Cell and Molecular Biology Resource Guide* and also at the Access Excellence web site (www.accessexcellence.org).
- Let students construct a pedigree based on their own family tree for simple traits like ear lobe (attached or free); tongue rolling, or hitch hiker's thumb.
- Let student run an actual gel for solving a paternity case or solve a murder. Kits can be obtained from various biological supply houses. A paper pencil simulation of gel electrophoresis can be obtained from the *Mississippi Cell and Molecular Biology Resource Guide* and also at the Access Excellence web site (www.accessexcellence.org).

Sample Test Item:

Questions were raised about the pedigree of a racehorse colt. DNA fingerprints were made from blood samples taken from the colt and the stallions in question. According to this information, which stallion was probably the sire (father) of this colt?

A Q
B R
C S
D T *

Competency 6: Investigate concepts of natural selection as they relate to diversity of life.

ASSESSMENT STRAND: NATURAL SELECTION

Objective 6a. Analyze how organisms are classified into a hierarchy of groups and subgroups based on similarities and differences.

Teaching Strategies:

- Give each group of students a bag containing different shapes of pasta. Let them group the pasta into a classification scheme. They can report to the class their group names and show the phylogenic relationships between the groups. They can make up their own scientific names for each group.
- Let students interview each member of the class as to their favorite color, class in school, shoe size, favorite food, t.v. show, etc. Let the students construct a dichotomous key to identify 7-8 students in the class.

Sample Test Items:

It is easy to group snakes based on color. However, a taxonomist would prefer a system that shows how the snakes –

A get their food
B shed their skin
C are able to hibernate
D are genetically related. *

Key to Some Animal Tracks

1a	Toe and side print connected	Go to 2
1b	Toe and side print separated	Go to 3
2a	Hind toe print webbed	Beaver
2b	Hind toe print not webbed	Opossum
3a	Toe print with claws	Fox
3b	Toe print without claws	Lynx

According to the key, this animal track belongs to the
A Beaver
B Opossum
C Fox
D Lynx *

Competency 6: Investigate concepts of natural selection as they relate to diversity of life.

ASSESSMENT STRAND: NATURAL SELECTION

Objective 6b. Identify characteristics of kingdoms including monerans, protists, fungi, plants, and animals.

Teaching Strategies:

- Give each group of students diagrams and pictures of different kinds of organisms that can be classified into the major kingdoms. Let the students cut out the pictures and form a collage for each major kingdom. Let the students write the major characteristic of each kingdom on the bottom of their collage. Post their work around the room.
- Give the students a description of an organism and ask "To what kingdom do I belong?" at the end of each description. Let the students solve the questions based on their notes.

Sample Test Items:

Paramecia, Euglena, and other single-celled pond water organisms belong to the kingdom

A Fungi.
B Plantae.
C Protista. *
D Animalia.

A slime organism was found that was multicellular, heterotrophic, but could not digest food inside its body. This organism would most likely belong to

A Fungi *
B Plantae
C Protista
D Animalia

Competency 6: Investigate concepts of natural selection as they relate to diversity of life.

ASSESSMENT STRAND: NATURAL SELECTION

Objective 6c. Differentiate among major divisions of the plant and animal kingdoms (vascular/non-vascular; vertebrate/invertebrate).

Teaching Strategies:

- Let the students list the major characteristics of each major group of Kingdom Plantae. Let them list examples for each group. Show the students examples of vascular vs. non-vascular plants.
- Let the students look at various invertebrates and vertebrate characteristics. Let them list examples of each type of animal. Discuss Phylum Chordata characteristics.

Sample Test Items:

The diagram above represents an organism belonging to the phylum –

A Arthropoda
B Chordata *
C Annelida
D Protozoa

Ferns may grow several feet in height, while mosses seldom grow more than a few inches high. This is primarily because mosses do NOT have

A vascular tissue *
B aerobic respiration
C sexual reproduction
D photosynthetic cells

Competency 6: Investigate concepts of natural selection as they relate to diversity of life.

ASSESSMENT STRAND: NATURAL SELECTION

Objective 6d. Compare the structures of functions of viruses and bacteria relating their impact on other living organisms.

Teaching Strategies:

- Let students make a general bacteria model using 16 oz. plastic bottles, fishing line for DNA and rubber bands for plasmids. Ideas for models can be found at the Access Excellence web site (www.accessexcellence.org). Discuss characteristics of bacteria along with pros and cons of bacteria on man (diseases, food production, food spoilage, etc.)
- Make a model of different viruses. Discuss why most scientists do not consider viruses alive.

Sample Test Items:

Antibiotics would be effective against –

A bacterial pneumonia. *
B the malaria protist.
C the flu virus.
D viral meningitis.

An organism that can reproduce ONLY inside a host cell is a –

A protozoan
B virus *
C fungus
D bacterium

Which of the following would NOT be a structure found in a virus?

A DNA
B RNA
C Protein
D Ribosome *

Competency 6: Investigate concepts of natural selection as they relate to diversity of life.

ASSESSMENT STRAND: NATURAL SELECTION

Objective 6e. Identify evidence of change in species using fossils, DNA sequences, anatomical and physiological similarities, and embryology.

Teaching Strategies:

- Analyze pictures or diagrams of sedimentary strata showing fossil layers. Discuss how the oldest fossils are found in the deeper layers.
- Compare similar structures in organisms such as a human arm, bird wing, and a whale fin. Discuss their similarities and differences. Define homologous and analogous in the discussion.
- Compare sequences of DNA in organisms for similarities and differences. Discuss how these organisms contain structures that are alike and different. Sample activities can be found at the Access Excellence web site (www.accessexcellence.org).

Sample Test Items:

Diagrams 1 and 2 show two undisturbed sedimentary strata with distinct layers. The layer that would contain the oldest fossils would be

(a) *

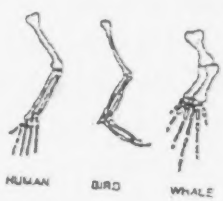
(b)

(c)

(d)

The diagram at right represents the forelimbs of three different organisms. These structures are classified as homologous because they

A demonstrate the law of use and disuse
B are identical in function
C represent acquired characteristics
D are similar in structure and origin *



Competency 6: Investigate concepts of natural selection as they relate to diversity of life.

ASSESSMENT STRAND: NATURAL SELECTION

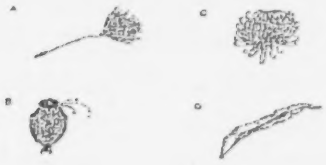
Objective 6f. Analyze the results of natural selection in speciation, diversity, adaptation, behavior and extinction.

Teaching Strategies:

- Students can act out food gathering with special adaptations. Sprinkle popcorn on a large piece of aluminum foil. Let the students try to pick up as many pieces as they can with their regular grasping hand, then with their fingers taped together, and with their fingers and thumb taped together with masking tape. Compare the number of popcorn kernels picked up in one minute. Discuss food getting strategies.
- Let students look at bird beak shapes and discuss how each would obtain food. Do the same thing with bird feet. Let the students decide their best habitat.
- Discuss behavior patterns of birds flying south for the winter and adaptation of dogs that live in colder climates growing thicker coats.

Sample Test Items:

Which of these seeds is dispersed by wind action?



What is the advantage to this insect of having this particular body shape?

A Food is easier to obtain.
B Predators are easier to avoid.
C Wind is easier to resist.
D Mates are easier to identify.

Competency 7: Investigate the interdependence and interactions that occur within an ecosystem.

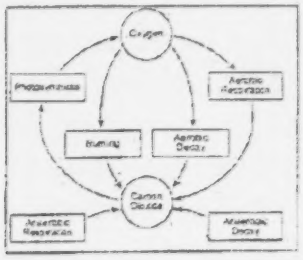
ASSESSMENT STRAND: ECOLOGY

Objective 7a. Analyze the flow of energy and matter through various cycles including carbon, oxygen, nitrogen and water cycles.

Teaching Strategies:

- Students can work in cooperative learning groups to make a poster of one cycle. They can present their posters to the class and describe their cycle with examples.

Sample Test Items:



The diagram shows how carbon dioxide and oxygen are recycled through the environment. Which process adds oxygen to the atmosphere?

A Respiration
B Burning
C Photosynthesis *
D Decay

Competency 7: Investigate the interdependence and interactions that occur within an ecosystem.

ASSESSMENT STRAND: ECOLOGY

Objective 7b. Interpret interactions among organisms in an ecosystem (producer/consumer/decomposer, predator/prey, symbiotic relationships, and competitive relationships).

Teaching Strategies:

- Let students analyze food webs and identify the producer, consumer and decomposer of each web.
- Give students examples of symbiotic relationships and let them identify each one.
- Let the students try to compete for "food." Sprinkle popcorn or peanuts on a piece of aluminum foil and let students try to grab handfuls of food. Let them see how some will be left out, and stress that the same thing occurs in nature.

Sample Test Items:

Which of the following represents a mutualistic relationship?

A Bee/flower *
B Mosquito/cat
C Spider/fly
D Wasp/ant

Bacteria are very important for the transfer of

A water from plants to animals.
B oxygen from plants to animals.
C nitrogen from animals to plants. *
D carbon dioxide from animals to plants.

Competency 7: Investigate the interdependence and interactions that occur within an ecosystem.

ASSESSMENT STRAND: ECOLOGY

Objective 7c. Compare variations, tolerances, and adaptations of plants and animals in major biomes.

Teaching Strategies:

- Let students research each biome and model one in a "box." "Biome in a Box" is an activity that can be found at the Access Excellence web site (www.accessexcellence.org) . Students can present their biomes to the class and discuss the unique characteristics found in each. They can also discuss sample plants and animals that could be found in their biome or draw pictures of each.

Sample Test Items:

Most of the Earth's rain forests are found near the –

A Arctic Circle.
B equator. *
C poles.
D prime meridian.

Which land biome is characterized by the presence of hardwood trees that shed leaves in winter, humus, and animals, such as, deer, fox and raccoons?

A Desert
B Taiga
C Temperate forest *
D Tropical rain forest

Competency 7: Investigate the interdependence and interactions that occur within an ecosystem.

ASSESSMENT STRAND: ECOLOGY

Objective 7d. Investigate and explain the transfer of energy in an ecosystem including food chains, food webs, and food pyramids.

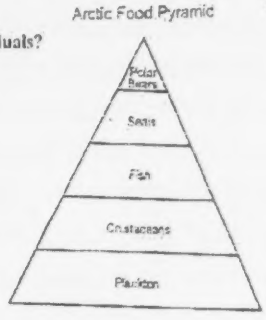
Teaching Strategies:

- Students can write down the food that they ate at their last meal. They can then try to form a food chain for each food that they ate.
- Students can construct a food web mobile composed of pictures (drawn or cut out of magazines). They can paste their pictures on cardboard and hang with string from a coat hanger. Each level of the food web will represent the biotic level. The organisms with the longest string are lower on the food web hierarchy than the ones closer to the coat hanger.
- Students can construct a food web from pictures and glue on poster paper. They can present these to the class.

Sample Test Items:

Which group contains the greatest number of individuals?

A Fish
B Seals
C Plankton *
D Crustaceans



Weeds → Grasshoppers → Robin → Snake → Hawk

Which of the following will MOST likely happen if the robin population in the food web shown above decreases?

A The variety of weeds in the area will decrease.
B Competition among grasshoppers will increase. *
C Parasites of grasshoppers will die out.
D Hawks will become grasshopper consumers.

Competency 7: Investigate the interdependence and interactions that occur within an ecosystem.

ASSESSMENT STRAND: ECOLOGY

Objective 7e. Examine long and short-term changes to the environment as a result of natural events and human actions.

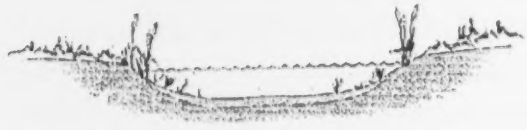
Teaching Strategies:

- Let students design an experiment with various items buried in soil placed in a 2-liter bottle with the top cut off. Let the containers sit for 2-3 weeks. Examine the items before and after the experiment. Let students report findings to the class.
- Set up a lab where students take 30 radish seeds and place in 10 ml of distilled water in between paper towels. The seeds can be placed in a petri dish or zip-lock bag. Repeat with 1% soap solution and 10% soap solution. Count the number of seeds that germinate and the length of the primary root for 5 days. Discuss the effect of soap on seed germination.

Sample Test Items:

The burning of coal and oil gives off a pollutant that eventually forms acid rain. What pollutant is this?

A Sodium phosphate
B Sulfur dioxide *
C Lead acetate
D Hydrogen chloride



The last stage of succession in this pond is that the pond will become –

A deeper and clearer.
B filled with soil. *
C polluted by acid rain.
D salty because of evaporation.

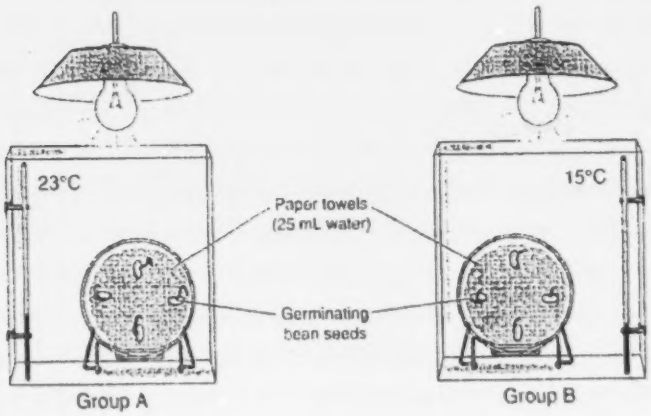
Section V

Skills Needed for Success on the Biology I Subject Area Test

1. OBSERVATION, INTERPRETATION, AND ANALYSIS

Students should be able to make observations in biology and interpret these observations. They should also be able to analyze the observations and draw conclusions. These skills are usually used together in laboratory experimental situations to design, set-up, and draw conclusions about a hypothesis. On the Biology I SAT these skills can be tested by giving the student a drawing of an experiment, graph, or organism and ask the student to choose the correct interpretation.

Sample1- Multiple choice:



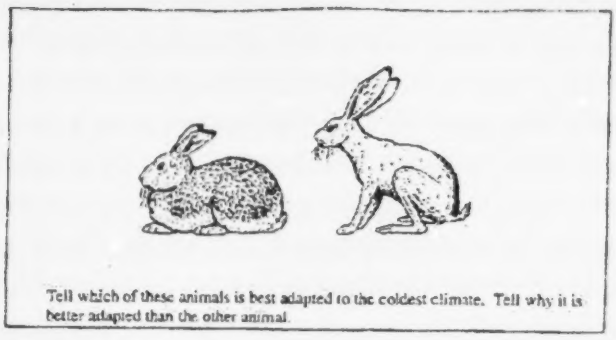
Which of these steps would most likely cause the seeds in Group B to grow faster?

A Transferring the plants to soil
B Changing the color of the light
C Raising the air temperature *
D Adding more water

In this example the student must use observation skills to notice the entire experimental set-up. They should note the temperature is different, seeds are the same, light is the same, paper towels and water is the same, and the seed primary roots are growing faster in Group A. By using the interpretation and analysis skills they should realize that the seeds are germinating faster in group A because the temperature is higher and choose C as the correct answer.

Students need practice with diagram, graphs, and experimental designs, to practice drawing correct conclusions.

Sample 2 – Open-ended:



Tell which of these animals is best adapted to the coldest climate. Tell why it is better adapted than the other animal.

In this particular situation, the student should observe that the rabbit on the left has longer fur, shorter ears, and a more compact body. Conclusions should be drawn that each of these characteristics is beneficial to survival in cooler climates. They should construct a paragraph to answer this question listing a specific adaptation and supporting with several reasons and examples why it is possible. Students should write their answers as if they were explaining the concept to another student.

2. COMPONENTS OF EXPERIMENTAL DESIGN

Students should be very familiar with the experimental process. They should practice this by actually setting up simple experiments, collecting data, organizing the data, and drawing conclusions. They should be familiar with the terminology involved in experiments, such as:

a. **Hypothesis** – testable statement based on previous research. Experiments are designed to test the hypothesis.
b. **Experiment** – testing under controlled conditions. An experiment should include two groups, one group that receives the experimental treatment and one group that receives all factors except the experimental treatment.
c. **Independent variable** – the variable being manipulated or tested in the experiment. It is used with the experimental group.
d. **Dependent variable** – variable being measured at the end of the experiment. It is measured in each group to see if the independent variable or experimental variable had an effect.
e. **Controls or Constants** – factors kept the same in each group in the experiment.

Students should collect and organize data during the experiment. They should be instructed in taking accurate measurements. The data may be recorded in a long in the form of a chart, or data table. Often the results are plotted on a graph. Scientists also use computers to record and organize experimental results.

Students will also use skills of making predictions, generalizations and drawing conclusions when designing and conducting experiments. The results of an experiment are collected and analyzed. For a conclusion to be meaningful, the experiment must be repeated many times, and the results obtained must be included in the analysis.

Sample question1:

Year	Population Count Each Spring				Spring Rainfall (in centimeters)
	Fish	Ducks	Frogs	Water Lilies	
2000	18	35	40	22	4.0
1999	17	32	14	18	2.7
1998	18	31	44	23	4.8
1997	16	34	50	22	7.7
1996	19	39	10	19	1.3

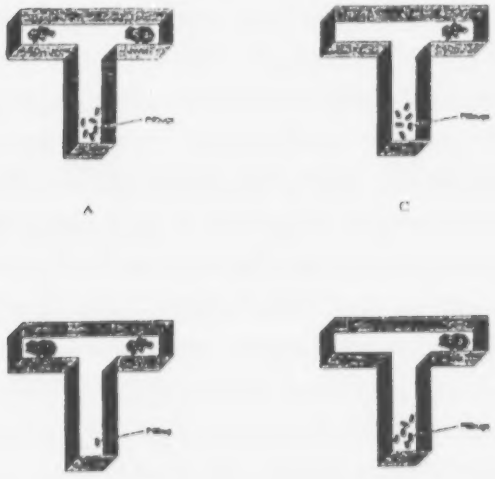
A small fishing pond was observed each spring. The total amount of rainfall and the population count for various species were recorded. The data table above shows five years of data. Suppose there was a major drought in the spring of 2001. According to the data shown in the table, which population would MOST likely be affected?

A Fish
B Ducks
C Frogs*
D Water lilies

Sample question 2:

Hypothesis: Pillbugs prefer wet dog food to dry dog food.

Which of these would be the best way to test this hypothesis?



A C

3. READING AND CONSTRUCTION OF GRAPHS

Graphing is an important procedure used by scientists to display the data that is collected during a controlled experiment. Line graphs must be constructed correctly to accurately portray the data collected. Many times the wrong construction of a graph detracts from the acceptance of a hypothesis. A graph contains five major parts:

a. **Title** – depicts what the graph is about. By reading the title, the reader should get an idea about the graph. It should be placed above the graph. Many graphs in texts do not have titles, but have detailed labeled axes.
b. **Independent Variable** – is the variable that can be controlled by the experimenter. It is placed on the X-axis (horizontal axis). Examples include time (dates, minutes, hours), depth (feet, meters), and temperature (Celsius).
c. **Dependent Variable** – is the variable that is directly affected by the independent variable. It is the result of what happens because of the independent variable. It is placed on the Y-axis (vertical axis).
d. **Scale for each variable** – In constructing a graph one needs to know where to plot the points representing the data. In order to do this a scale must be employed to include all the data points. This must also take up a conservative amount of space. The scales should start with 0 and climb based on intervals such as multiples of 2, 5, 10, 20, 25, 50 or 100. The scale of numbers will be dictated by your data values. This equation may help:

$$\frac{\text{Largest number on graph axis} - \text{smallest number on same axis (from data table)}}{\text{Number of available lines (divisions) on graph paper}}$$

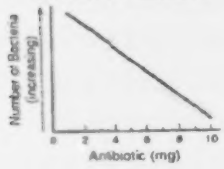
Solving this equation often helps one choose which number increment to use.
e. **Legend** – a short descriptive narrative concerning the graph's data. This is not always necessary if the graph is only plotting one independent variable. It should be short and concise and placed under the graph.

Students should also be familiar with reading graphs. This requires practice on worksheets and weekly test items.

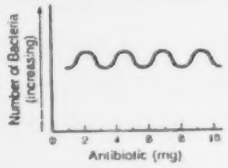
Sample item:

The results of an experiment showed that as the amount of antibiotic increased from 1 milligram to 10 milligrams, the number of bacteria decreased. Which graph correctly shows the experimental data?

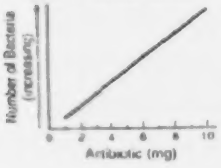
A



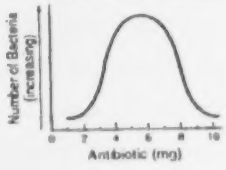
C



B



D



4. USING TOOLS IN THE LABORATORY

Students should be familiar with using laboratory measurement tools and microscopes for success on the test. They should know the names of and how to use common glassware used for measuring (graduated cylinders, beakers, flasks), pipettes, rulers, and thermometers. Students should also be familiar with the microscope and slide preparation.

In using the compound microscope, begin by viewing the specimen with the low power objective, focusing first with the coarse adjustment, then with the fine adjustment. The objectives can then be switched from low power to high power.

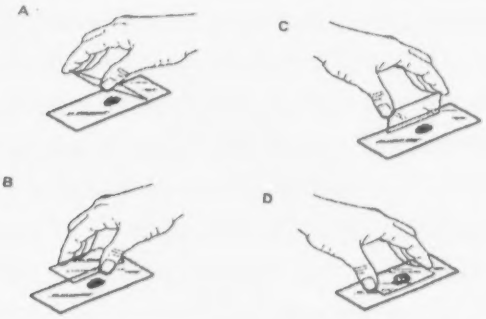
The image of an object seen under the microscope is enlarged, reversed (backward), and inverted (upside down). When viewed through the microscope, an organism that appears to be moving to the right is actually moving to the left. An organism that appears to be moving toward the observer is actually moving away from the observer.

Total magnification is found by multiplying the eyepiece lens times the objective lens. For example, if the student is viewing the slide using the 40X objective lens and the eyepiece is 10X, the total magnification is 400 times. 10X x 40X = 400X total magnification.

Making a wet mount slide:

1. Use a dropper to put one drop of water in the center of the slide.
2. Place the tissue or organism on the water drop.
3. Cover the specimen with a cover slip by placing it at a 45-degree angle and slowly lowering the cover slip over the specimen, avoiding air bubbles.
4. To stain the section, add a drop of iodine solution or methylene blue at one edge of the cover slip. Touch a small piece of paper towel to the opposite side of the cover slip to draw the stain across the slide and through the specimen.

Sample question:



Appendices

Appendix A

Glossary of Terms

Alternative Assessment – Any type or assessment in which students create a response to a question, as opposed to assessments in which students choose a response from a given list, such as multiple-choice, true/false, or matching. Alternative assessment can include short answer questions, essays, performance assessments, oral presentations, exhibitions, demonstrations, and portfolios.

Analytical Trait Scoring- A performance is judged several times along several different important dimensions or traits of the performance. Use of a scoring rubric and anchor paper for each trait is common. An example might be judging of student problem solving for understanding the problem, correct use of procedures and strategies, and the ability to communicate clearly what was done.

Anchor papers or benchmark performances – Examples of performances that serve as a standard against which other papers or performances may be judged; often used as examples of performances at different levels on a scoring rubric.

Assessment Strand – Competencies used for test construction purposes are combined for reporting purposes into assessment strands. The test items are written to evaluate the competencies not the assessment strands.

Authentic (assessment) – Assessment tasks that elicit demonstrations of knowledge and skills in ways that resemble "real life" as closely as possible, engage students in the activity, and reflect sound instructional practices.

Benchmarks- Statements of what students should know and do by certain grade levels or times.

Benchmark performance – See "anchor papers".

Blueprint – The blueprint indicates the number of items from each assessment strand that must appear on a test.

Competency/Item match- There must be alignment between a given competency and an item that measures the competency.

Context (of an alternative assessment) – The surrounding circumstances within which the assessment is embedded. For example, problem solving can be assessed in the context of a specific subject (for example biology) or in the context of real-life laboratory problems requiring the use of mathematical, scientific, social studies, and communication skills and tools.

Constructed Response – A constructed response item is a type of free response or open-ended question with more than one possible right answer. It is scored using a rubric and scoring guide.

Core items – This term refers to the body of scorable test items that count toward the student scores.
Criterion referenced test (CRT)- CRT's are constructed to assess a student's understanding of given competencies or objectives. The Mississippi subject area tests are criterion – referenced.

Distractors- The incorrect answers to a multiple-choice item are called distractors.

Enhanced multiple-choice – This is a question which elicits the use of a students prior knowledge, integrates knowledge and process skills and uses an "enhancement" (e.g., map, chart, graph, speech excerpt, etc.).

Evaluation – This process uses a judgement regarding the quality or worth of the assessment results. Evaluations are usually based on multiple sources of assessment information.

Field – test items – Field –test items have never been on a test before. These items have no statistical data and are not counted for or against the students' scores. Once these items have been tested and statistically evaluated, they may appear on new forms of the test, or they may be deleted. Field test items are not identified on the test so students will not know which items count and which do not.

Item- This term refers to a single question or problem in a test.

Multiple-choice items- Multiple choice items ask students to choose the correct or best answer from several given answers or options. MSATP items are both multiple choice and open ended.

Objective- This term refers to the knowledge, skill, process, or strategy that an item measures.

Options – This term refers to the possible responses in multiple –choice items, including the correct response and all distractors.

Selected response item- This is another term for a multiple – choice item.

Standardized test- This term refers to a test that contains the same content administered in the same way for everyone taking the test.

Stem- The item stem actually states the problem. This can be posed as a question or as an incomplete statement.

Stimulus- The item stem, piece of art, or referent that prompts a response is called a stimulus.

Test construction- This term encompasses selecting the items that go into each form of a test and then arranging them in an appropriate sequence.

Appendix B

Suggested Web Links for Additional Resources *(from the MDE Science Website)*

The Elephants of Cameroon
http://www.nczooeletrack.org
Track the project of radio-collaring to study the land-use patterns of the Cameroon elephants.

The Bridge
http://www.vims.edu/bridge
Ocean Sciences Education Teacher Resource Center connecting marine education to all other fields of science.

Monarch Watch
http://www.MonarchWatch.org/
This site covers the migration of this butterfly as well as promoting conservation of the species.

Journey North: A Global Study of Wildlife Migration
http://www.learner.org/jnorth/
This project presents methods to track birds and butterfly migrations, reports migration progress with maps, gives weather forecasts for migrating birds and provides classroom lessons for tracking migration.

Wildflowers in Bloom
http://aggie-horticulture.tamu.edu/wildseed/wildflowers.html
Click on a wildflower's name to see a picture and to see if it will grow in your area.

School Gardens
http://aggie-horticulture.tamu.edu/nutrition/schoolgardens/schgard.html
A complete guide for planting a school garden along with ideas and curricula to go with it.

Genetic Science Learning Center
http://gslc.genetics.utah.edu/aboutgslc.html
A joint project of the University of Utah and the Utah Museum of Natural History to help people understand how genetics affects their lives and society.

Animals of the Rainforest
http://www.animalsoftherainforest.org
Visit this site for photos and information about habitat, diet, and enemiesof some of these vanishing species.

The Human Body Adventure
http://www.vilenski.com/science/humanbody
Begin with the skin (the body's largest organ) and travel through different layers from muscles to systems to senses.

Gene School
http://library.thinkquest.org/28599
Students will find an overview of the genetics field and a starting place for finding out more about genetics.

DNA for Dinner?
http://www.gis.net/~peacewp/webquest.htm
This site helps students use the internet to learn about the genetic engineering of food crops.

At Sea
http://www.at-sea.org
This site immerses students in marine science research, including daily dispatches from worldwide expeditions that feature written reports and video clips.

Reefwatch
http://www.amnh.org/learn/reef_watch
This site, sponsored by the American Museum of Natural History, follows a group of scientists as they investigate the health of the coral reefs in the Florida Keys, including a presentation on why coral reef systems are endangered around the world.

Bugscope
http://bugscope.beckman.uiuc.edu
Magnify learning in a whole new way. Using a microscope controlled over the internet, K-12 students around the country can get a close-up view of bugs.

Colorado State University Entomology Site
http://www.colostate.edu/Depts/Entomology/ent.html
Visit the Colorado State University Entomology site for links to photos, drawings, movies and further resources about insects.

Iowa State University's Tasty Insect Recipes
http://www.ent.iastate.edu/misc/insectsasfood.html

"Sci4Kids"
http://www.ars.usda.gov/is/kids
Great site from the US Department of Agriculture's Agricultural Research Service(ARS) that proves "science is everywhere you look". Also has a section called "Dr. Watts" where kids can e-mail their questions to ARS scientists.

Seeing, Hearing and Smelling the World
http://www.hhmi.org/senses
This site, from Howard Hughes Medical Institute, features current research to help you make sense of the senses. Contains articles and graphics.

JASON Project
http://www.jasonproject.org
An integrated, multimedia, science education program based on the National Science Standards. Follow the exciting adventures and learn how to become a part of this project. Winner of the Computerworld Smithsonian Award in Education and Academia.

National Wildlife Federation
http://www.nwf.org
A web site full of good information for environmental education. Also, access photos and articles from several popular nature magazines. Cool place for kids to play games or go on virtual tours.

The Albatross Project
http://www.wfu.edu/albatross
Join Biologist, David Anderson of Wake Forest University, in the satellite tracking of two species of albatross, a type of seabird. Research opportunities targeted for students in grades three - seven. Participation is absolutely without charge.

Honolulu Community College Dinosaurs
http://www.hcc.hawaii.edu/dinos/dinos.1.html
What child (or adult) can pass up the opportunity to learn more about these giant creatures. Nice graphics and links to enhance any unit on dinosaurs.

Carl Hayden Bee Research Center
http://gears.tucson.ars.ag.gov/
This multimedia wonderland may have you dressing up like a beekeeper to hunt the elusive virgin queen bee. Find out how to handle the swarming African honey bees, a.k.a. the dreaded "killer" bees.

The World Through The Eyes of A Bee
http://cvs.anu.edu.au/andy/beye/beyehome.html
Have you ever wondered how other creatures see the world? Here you can find out. Well, at least you can find out how HONEY BEES see the world. Well, let's say you can find out what we THINK the world looks like to a bee.

Access Excellence (Biology)
http://www.gene.com:80/ae/
Access Excellence is a national educational program sponsored by the biotechnology industry pioneer, Genentech, Inc., that puts high school biology teachers in touch with their colleagues, scientists and critical sources of new scientific information through an online network.

In Search of Giant Squids
http://seawifs.gsfc.nasa.gov/squid.html
Follow the Smithsonian scientists in their quest for the elusive giant squid. There will be a special pilot program with the Smithsonian Institution and Northeast Mississippi students to become intimately involved with this program.

TheYuckiest Site on the Internet
http://www.yucky.com
Did you know that if you're ever stung by a sting ray, you can apply scrunched up cockroaches to he wound to make it heal faster? On this page, you can find out all sorts of things about the cockroach and other bugs, besides what you think you know of them already. The best place for science entertainment.

Virtual Frog Dissection Kit
http://www-itg.lbl.gov/vfrog/
Ugh! Yeck! How about a unique way to dissect a frog without destroying the frog population or having your students accidentally cut themselves.

The Interactive Frog Dissection
http://curry.edschool.Virginia.EDU/~insttech/frog
Just how many ways can you cut up those poor frogs??? Another site for dissecting the frog.

Cells Alive!
http://www.cellsalive.com
Short paragraphs with pictures, movies and animations makes this investigation of blood cells exciting.

Neuroscience for Kids
http://faculty.washington.edu/chudler/neurok.html
The nervous system is explained in text and illustrations designed for children. Activities and experiments are provided.

The Heart
http://sln.fi.edu/biosci/heart.html
The Franklin Institute presents this compelling presentation on the human heart. Explore the heart. Discover the complexities of its development and structure. Follow the blood through the blood vessels. Wander through the web-like body systems. Learn how to have a healthy heart and how to monitor your heart's health. Look back at the history of heart science.

Welcome To Steve's Ant Farm
http://www.atomicweb.com/antfarm.html
This page houses a relatively live picture (updated every five minutes) of Steve Chambers' ant farm. It's now available 24 hours, so you can peek in on the industrious little fellows any time. There's also a movie file of the ants here, so you can get the creepy-crawlies even when you're not connected.

"Bugs" in the News
http://falcon.cc.ukans.edu/~jbrown/bugs.html
A professor of microbiology provided background information and explanations of viruses, bacteria and other "bugs" in the news.

Stellaluna's Friends
http://www.webcom.com/suealice/stellaluna
Eveything you want to know about bats and more. Also has links to other "batty" websites.

O. Orkin Insect Zoo Curriculum Module
http://NaturalPartners.org/InsectZoo
Visitors can enjoy a virtual tour of the Insect Zoo at the National Museum of Natural History in Washington, D.C. Curriculum materials, handouts, facts about adherence to the National Science Education Standards, and bibliographies of books and audiovisual materials are also included. EdTech '98 Website WINNER!

Flinn Scientific
http://www.flinnsci.com
Good ideas for Lab safety, contact numbers for FREE Reference Manual.

BIGChalk.com-The Edcation Network
http://www.bigchalk.com
All sorts of stuff for the up-to-date educator!

Science Websites
http://home.postnet.com/~grichert

High School Science Fair Ideas
http:// www. stemnet.nf.ca/sciencefairs/senior.html
Choose your area of interest then click on the subtitle for a wealth of ideas.

Science Fair Central
http://school.discovery.com/sciencefaircentral
This site is designed to encourage interest and participation in science fair competitions across the country.

The ENC Inquiry and Problem-Solving Site
http://www.enc.org/focus/topics/inquiry/index.htm
Inquiry and problem solving are central to standards-based teaching of mathematics and science. Articles show how classroom teachers all over the country encourage their students to become inquirers and problem-solvers.

Free and Nearly Free Stuff
http://www.worldbank.org/worldlinks/english/html/free.html
This site from the World Links for Development Program offers information that is free or nearly free for schools.

FREE Federal Resources for Educational Excellence
http://www.ed.gov/free
New science education activities listed on the US Department of Education website.

The Gateway to Educational Materials (GEM)
http://www.thegateway.org
Announced by U.S. Secretary of Education, Richard Riley, this is a site designed for teachers to type a topic, grade level, and other information into a search screen that then retrieves -from more than 140 websites- lessons, instructional units, and other free educational materials on that topic for that grade level.

Awesome Science Library
http://www.2.awesomelibrary.org/scienceg.html
A virtual Science library with lesson plans, ideas, and papers for almost every topic

The Lab Safety Workshop
http://www.labsafety.org/
Site dedicated to making health and safety an integral and important part of science education. Free copies of Lab Safety Guidelines available on request.

Women in Science
http://hyperion.advanced.org/20117/
This site includes the first International Registry for Women in Science, electronic field trips, a mentoring area, on-line interviews, biographies, and more.

Magnolia Database
http://nt.library.msstate.edu/magnolia
Mississippi Alliance for Gaining New Opportunities through Library Information Access, a collection of databases for elementary children to adults.

Mississippi Science Teachers Association
http://www.misssta.org
Mississippi's chapter of the national organization. Includes great links and other science information. Currently under construction, but open.

National Science Teachers Association
http://www.nsta.org/
Offers visitors a wealth of information about the organization itself, programs, convention information and dates, publications, awards, and competitions.

Smithsonian's National Zoological Park
http://www.si.edu
Why wait to go to Washington D.C. to visit our National Zoo?? Discover the excitement of a field trip to the zoo without the lines, spilled drinks and sore feet!

The Franklin Institute
http://sln.fi.edu/
Visit the publications library, where you'll find other science news, activities, and resources. Use their units of study to support your science curriculum. Sample some interesting science programs and demonstrations. Wander through the museum. It's not quite the real thing, but a visit to this online museum should satisfy your yearning for learning about science.

The Exploratorium Science Snacks
http://www.exploratorium.edu/snacks/snackintro.html
Pages full of snacks - but not the kind you eat! Minature versions of some of the most popular exhibits at the Exploratorium.

Exploratorium Home Page
http://www.exploratorium.edu/
In this virtual Exploratorium, visitors can discover the wonder of genetics and DNA coding first-hand from a throng of mutant fruit flies. Site visitors will find plenty of suggestions for putting together their own experiments and exhibits at home with excerpts from two Exploratorium books, Hands-On Science and The Science Snackbook.

Project Learning Tree
http://www.plt.org
This is their national home page. Site visitors will find sample activities, a calender of events, and PLT's curriculum.

National Science Resources Center
http://www.si.edu/nsrc
Operated jointly by the Smithsonian Institution and the National Academy of Sciences.

Science NetLinks
http://www.sciencenetlinks.com
Designed specifically for teachers, parents and libarians, Science NetLinks is a detailed guide to the best science resources on the internet.

The Annenberg/CPB Channel
http://www.learner.org/channel
Information about the mathematics and science network.

Science Around the World
http://now2000.com/bigkidnetwork/kidsworldindex.html
A magical ticket for an around the world trip to great science spots, museums, zoos and aquariums. Great kids site.

Appendix C

Technology Connections *(for 9-12 from the 2001 Mississippi Science Framework)*

TITLE	COMPANY
A.D.A.M. The Inside Story	Carolina
Biology with Computers	Venier Software
Chemistry Comes Alive	Journal of Chemical Education
Chemistry Skill Builder Electronic Homework	Spain Co.
Chemistry with Computers	Venier Software
ChemLab	Corel Corporation
Chem-media	Prentice-Hall
Cliff Notes – Chemistry	Cliff Notes
Imagine the Universe	NSTA
Inventing the Future: African American Contributions to Scientific Discovery and Invention	American Chemical Society
Molecules 3-D	Flinn Scientific
Rainforest Researchers	Tom Snyder
Science and Nature: Elements	Virgin Records America, Inc.
Science and Nature: Materials	Mentorom Multimedia
Science Court	Tom Snyder
Science Master: Biology, Chemistry, Physics	Super Tutor Company
The Digital Frog	Prentice-Hall
The Great Ocean Rescue	Tom Snyder
Timeliner	Tom Snyder

Appendix D

Literature Connections *(for 9-12 from 2001 Mississippi Science Framework)*

Andrews, Michael	THE LIFE THAT LIVES ON MAN. New York: Tapliner, 1977. Describes the ecology of the arthropods and bacteria that live on humans.
Astor, Gerald	THE DISEASE DETECTIVES. New York: New America Library, 1984. Follow CDC epidemiologists as they uncover the causes of deadly diseases.
Barber, Jacqueline	CHEMICAL REACTIONS. Students use sealable sandwich bags as a laboratory for mixing chemicals.
Barker, Rodney	AND THE WATERS TURNED TO BLOOD. A non-fiction account of *Pfiesteria piscicida* in Chesapeake Bay. A great account of how scientific research takes place.
Beason, Ann	THE PLAGUE TALES. A novel of adventure and science, romance and terror, two eras are joined by a single trace of microscopic bacterium – the invisible seeds of a new bubonic plague.
Bedenbaugh, Angela and John	TEACHING FIRST YEAR CHEMISTRY. Vol. I and II. Department of Chemistry and Biochemistry, University of Southern Mississippi, 1993. Full year curriculum including activities, demonstrations, and other resources.
Benchley, Peter	THE BEAST. New York: Random House, 1991. Coral reef ecology is disturbed and a giant squid picks man as his new prey.
Brin, David	EARTHCLAN: STARTIDE RISING: Garden City, NY: Nelson Doubleday, 1987. Genetic manipulation, origin of man: intelligent dolphins and chimpanzees cooperate with man in the exploration of space.
Carr, Terry (ed.)	SCIENCE FICTION FOR PEOPLE WHO HATE SCIENCE FICTION. New York: Doubleday, 1996. Ecology and the human impact on the environment.
Clarke, Arthur	2001: A SPACE ODYSSEY. London: Octopus, 1985. Ecosystems necessary for terraforming are described.

Cook, Robin	CHROMOSOME 6. The sale of organs through genetic engineering.
Cook, Robin	MORTAL FEAR. New York: G.P. Putnam and Sons, 1988. Eyedrops accelerate the aging process.
Cook, Robin	MUTATION. The consequences of genetic engineering experiments.
Cook, Robin	TOXIN. A gripping novel of bacterial poisoning and corporate cover-up in the food industry.
Cook, Robin	VECTOR. This novel shows the unthinkable (bio-terrorism in New York City) becoming stark reality.
Crichton, Michael	JURASSIC PARK. New York: Alfred A. Knopf, 1990. This fictional account of a theme park featuring dinosaurs cloned from DNA in mosquitoes fossilized in amber lends itself to many interesting discussions of genetic engineering, ethical issues, and chaos.
Crichton, Michael	SPHERE. New York: Alfred A. Knopf, 1987. The discovery of an ancient spacecraft deep in the ocean is the focus of a scientific probe.
DeKruif, Paul	MICROBE HUNTERS. New York: Harcourt, Brace, and World. The stories of Leeuwenhoek, Koch, Pasteur and others are presented in an interesting narrative.
Discover Journal	THE BIOLOGY OF HANDWASHING. December 1999.
Dixon, Bernard	MAGNIFICENT MICROBES. New York: Atheneum, 1976. A best-selling account of our dependence on microbes.
Emsley, John	ELEMENTS. Oxford University Press, 1998. Fifty important facts about each element.
Emsley, John	THE ELEMENTS. 1993 A reference that displays in alphabetical order the chemical elements with information about them.

Flinn Scientific	CHEMICAL AND BIOLOGICAL CATALOG AND REFERENCE MANUAL. Flinn Scientific (annual). Contains information about laboratory safety, chemical storage, chemical disposal, eye safety, solution preparation and other teaching techniques. Available for FREE!
Garrett, Laurie	THE COMING PLAGUE. Contains chapters on many diseases affecting man.
Gould, Stephen Jay	WONDERFUL LIFE. All of Gould's books are excellent sources for information about natural history. Students enjoy reading or listening to excerpts from his books.
Hairston, Rosalina and Sampsell, Jackie (contacts)	MISSISSIPPI BIOLOGY TEACHERS RESOURCE GUIDE IN CELL AND MOLECULAR BIOLOGY. Supplementary activities that can be used in the study of the cell, molecular biology, genetics and evolution. For ordering information, please write: MS Biology Teachers Resource Guide, University of Southern Mississippi, Southern Station-Box 5087, Hattiesburg, MS 39406.
Harris, Robin Lee	SCIENCE AND WRITING CONNECTIONS. Freedman. This book incorporates writing into science instruction and evaluation.
Harrison, Harry	WEST OF EDEN. New York: Bantam Books, 1984. Imagine a world where dinosaurs did not die but survived to develop their own civilization. Their culture comes into conflict with an emergent human race.
Herbert, Don	MR. WIZARD'S SUPERMARKET SCIENCE. 1999, Econo-Clad Books. Experiments include making glue from milk, gelatin stalagmites, sugar from marigold odor, etc.
J.L. Scott Marine Educational Center	FREE LEAFLETS about: Blue crabs, shrimp, Barrier Islands, Jellyfish, worms, marshes, Echinoderms and many more. Biloxi.
Levin, Ira	THE BOYS FROM BRAZIL. New York: Random House, 1976. Dr. Mengele attempts to produce cloned copies of Adolf Hitler, but in order to do so he must reproduce the environmental factors which made Hitler the evil genius that he was; deals intelligently with the fashionable subject of cloning.

Lewis, Grace Ross	1,001 CHEMICALS IN EVERYDAY PRODUCTS. 1994. This book contains information on more than 1,000 chemicals of common household products.
Lien, Tik L.	INVITATIONS TO SCIENCE INQUIRY. 2nd Ed. Science Inquiry, 1987. Demonstrations and activities on air, weather, properties of matter, energy, heat, magnetism, electricity, light, sound, forces, and living things.
Macaulay, David	THE WAY THINGS WORK. Houghton Mifflin Co., 1988. Clear, humorous writing explores the inner working of machines and scientific processes in terms students can appreciate.
MS Highway Department	BROCHURE OF MISSISSIPPI WILDFLOWERS. A free publication that has good photos of many wildflowers commonly seen along Mississippi highways.
National Science Teacher Association (NSTA)	THE SCIENCE TEACHER. Periodical designed for junior and senior high school science teachers. Contains demonstrations, experiments, sources of teaching, materials, and other teaching ideas.
Nourse, Alan E.	THE BLADE RUNNER. New York: D McKay and Co., 1974. In a future of increased human longevity, doctors struggle to cope with problems of overpopulation, hereditary disorders, and virulent new diseases.
Preston, Richard	THE HOT ZONE. A non-fiction account of *Ebola* breakout and the investigation by the CDC.
Rhodes, Richard	DEADLY FEASTS. A non-fiction account about mad cow disease.
Rosebury, Theodor	LIFE ON MAN. New York: Viking Press. A humorous yet scientific account of the role of microbes on the human body.
Thomas, Lewis	THE LIVES OF A CELL. New York: Viking Press, 1974. Several articles in this delightful book discuss bacteria and their relation to health and disease.

Timme, S. Lee	WILDFLOWERS OF MISSISSIPPI. Jackson: University of Mississippi Press, 1989. Good color photo guide to Mississippi flowers. (not a key)
VanCleave, Janice	BIOLOGY FOR EVERY KID. Fast and easy activities or demos.
Verne, Jules	20,000 LEAGUES UNDER THE SEA. London/New York: J.M. Dent, 1908. Underwater adventures with sea creatures, technology of sea exploration.
Vonnegut, Kurt	GALAPAGOS. New York: Delacorte Press/Seymour Lawrence, 1985. An observant ghost haunts the Galapagos Islands for a million years and watches as the descendants of a few marooned humans devolve into a new species.
Wartski, Mark	LOW BUDGET BIOLOGY. This book has easy, low-cost activities that provide meaningful learning experiences.
Watson, James D.	THE DOUBLE HELIX. A great story for advanced students to read. Gives insight into what goes on in scientific research.
White, Michael and Gribbin, John	DARWIN: A LIFE IN SCIENCE. Biography.
Wills, Charles	THE VISUAL DICTIONARY OF PLANTS. New York: DK Publishing, Inc., 1992. Excellent photos of plant anatomy.
Wood, Clair	SAFETY IN SCHOOL SCIENCE LABS. Walch, 1991, Helps plan, instruct, supervise, and maintain a safer science lab.

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